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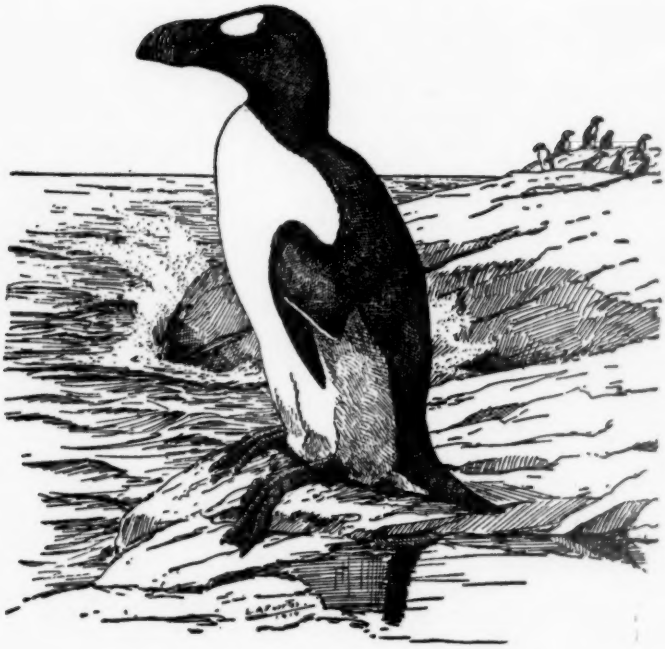

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ON A COLLECTION OF BIRDS FROM GEORGIA AND CAROLINA MADE ABOUT 1810 BY JOHN ABBOT

BY ERWIN STRESEMANN

In 1810 the Zoological Museum of Berlin University was founded, and the indefatigable Dr. Carl Illiger became its director. At that time, his interest had turned to birds and mammals from all parts of the world. The ornithological collection, however, with which he had to start consisted chiefly of European and Brazilian birds. The latter had been given by the Count Johann Centurius von Hoffmannsegg, Illiger's friend and promoter, who, while in Portugal, had sent a special collector to the Lower Amazonas in 1801. After an absence of almost 11 years, this man, Friedrich Wilhelm Sieber, returned to Berlin in June, 1812, bringing with him not only what he had collected in the State of Pará during the last years, but also a good many bird skins from New South Wales and the United States. He had exchanged Brazilian skins for these on his way home, when circumstances had compelled him in 1811 to stay for some time in London. (See Illiger's letter to C. J. Temminck, dated 14 September 1812, and published by Stresemann, 1950: 135–136.) Particulars about Sieber's London arrangements have not yet been disclosed; but I was able to show that the Australian skins which he had obtained there were part of George Caley's important collection formed in the vicinity of Parramatta between 1801 and 1810 (Stresemann, 1951a: 70).

The North American birds by which the young collection of the Berlin Museum became increased had been labelled "Georgia" and "Carolina." They included 93 species and 130 specimens—perhaps the most complete local collection that had been shipped from the United States to Europe.

Like all new material from other countries, these North American birds were at once carefully studied by Illiger. When labelling them, their collector had not only stated the region ("Georgia" or "Caro-

lina"), but had, at least in some cases, added a vernacular designation and may even have quoted a scientific name from Gmelin or Latham, augmented by references to the works of Catesby, Edwards, and Buffon. This, however, is not certain, because the original labels have not been preserved, and the catalogue of August, 1813, to be mentioned below, does not make any distinction between the text of the labels and Illiger's additions. Among the latter, one notices references to the manuscript of Marcgrave, preserved in the Royal Library, Berlin, and to a manuscript on the animal life of Louisiana, Florida, etc. written by Professor Joseph Märter of Vienna, who had been there about 1785.

Illiger was not acquainted with Vieillot's "Histoire naturelle des oiseaux de l'Amérique septentrionale" (1807–1808), nor had he seen Wilson's "American Ornithology" (Vol. I–VI, 1808–1812). This explains why he gave new names to some species recently described by these authors. Before being able to publish his taxonomic results, this brilliant systematist died of consumption on May 10, 1813. (A biography of Illiger is included in Stresemann, 1951b.)

He was succeeded by Dr. Hinrich Lichtenstein, a vain and superficial person with hardly any experience in taxonomy, who at once started writing a new inventory of the ornithological collection of the Berlin Museum (960 species), thereby copying all remarks of Illiger which he could assemble. This task he completed in August, 1813, but only after ten or more years were some of the new specific names which Illiger had given to North American birds published by Lichtenstein or other German authors, with or without a diagnosis added. Three of these have been incorporated in the A.O.U. Check-List of North American Birds: *Fringilla* [*Aimophila*] *aestivalis* Lichtenstein 1823 ("Georgia"), *Troglodytes* [*Cistothorus*] *stellaris* Naumann 1823 ("Carolina"), and *Regulus satrapa* Lichtenstein 1823 ("Am. sept."); others, like *Ardea adspersa* Illiger for *Botaurus lentiginosus* (Montagu 1813), appear in the synonymies.

To disclose the identity of the collector had been my aim for many a year, when finally the perusal of Mrs. E. G. Allen's "History of American Ornithology before Audubon" (1951) resulted in the discovery of a promising track. The writer devotes a special chapter (pp. 543–549) to "John Abbot of Georgia" (1751–1840?), in which she combines a variety of biographical notes, derived from many sources, to draw an interesting sketch of his life and work.

After having lived at other places in Georgia since 1776, John Abbot made Savannah his residence in 1806 and there occupied himself with studying insects and drawing birds in color (Basset, 1938). Mrs.

Allen was able to trace five different sets of drawings of Georgia birds from Abbot's able brush, three in England and two in the United States. One, the DeRenne set, was dated 1797; another, the Egerton set, was dated 1804; and a third, the Boston set, was drawn between 1800 and 1810 and represented about 190 species (Faxon, 1896).

It was generally believed that Abbot used to make drawings of the birds which he had secured, without preserving their skins, and this may have been true up to February and March of 1809 when Alexander Wilson payed a visit to Savannah and became Abbot's friend. Writing about his new species *Muscicapa solitaria* [= *Vireo solitarius* (Wilson)], Wilson remarks: "It is occasionally found in the State of Georgia, where I saw a drawing of it in the possession of Mr. Abbot, who considered it a very scarce species. He could give me no information of the female." But soon afterward Abbot started forming a bird collection. This becomes apparent from a letter which he wrote to George Ord from his new residence in Scriven County, Georgia, in March, 1814, (and published by Witmer Stone, 1906), wherein he stated: "At the commencement of the war [in 1812] I had undertaken to make a collection of stuffed Birds & as a complete collection of Drawings of them in colors as I was able for a Gentleman in England but last fall in despair of seeing peace restored, I retired into the Country after having made about 220 Drawings throwed away a large collection of stuffed skins, have entirely laid it aside, & entered into another line of employment, where I am in hopes the mad and destructive Ambition of the rulers of the world can but little interfere." And Wilson wrote to Abbot from Philadelphia on 23 January 1812: "Dear Sir, I this day rec'd . . . 4 Birds viz. the small Crow, female solitary Flycatcher, and the male and female Ground dove all in good order. The Crow and the Flycatcher I had already figured. The other two were very welcome; . . . . Please to send the Chuck wills widow (male) and egg, and the beautiful rare Sparrow you mention, also the striped Wren." (The latter probably referred to *Cistothorus stellaris*.)

There are several means for testing the theory that it was John Abbot who had formed the "Sieber" collection of North American birds.

1.) The localities. These are given as Georgia, or Carolina, without exception. Savannah lies on the Savannah River which separates these states.

2.) The species represented. They include the very local Pinewoods Sparrow [*Aimophila aestivalis* (Lichtenstein)], which in later years was taken by J. Leconte near Savannah. They further include

Vireo solitarius (Wilson 1810), a drawing of which had been shown to Wilson by Abbot.

3.) The vernacular names. These are: "Summer Sparrow" for *Aimophila aestivalis;* "Yellow-pinioned Sparrow" for *Ammodramus savannarum pratensis* (Vieillot 1817), named by Illiger (in MS) *Fringilla xanthocampter;* "Red Sparrow" for *Passerella iliaca;* "Spotted Grass-Sparrow" for *Passerherbulus caudacutus;* "Cinereous headed Flycatcher" for *Vireo solitarius* (Wilson 1810), named by Illiger (in MS) *Lanius poliocephalus;* "Rust-spotted-back's Warbler" for ? ; "Red-streaked headed Woodpecker" for *Dendrocopos borealis* (Vieillot 1807), named by Illiger (in MS) *Picus leucotis;* "Barred-tailed Sandpiper" for *Tringa solitaria* Wilson 1813, named by Illiger *Tringa* sp.? It is to be hoped that these vernacular names will one day be compared with the English names given on the Abbot drawings. In the list of the DeRenne plates (1797) published by Rhoads (1918) *Tringa solitaria* is called "Barred tail Sandpiper" on pl. 13, and *Aimophila aestivalis,* is called "Summer Sparrow" on pl. 93, while *Passerella iliaca* appears as "Fox coloured sparrow" (pl. 54), *Ammodramus savannarum pratensis* as "Yellow winged Sparrow" (pl. 97), and *Vireo solitarius* as "Solitary Flycatcher" (pl. 114).

4.) The period (1811) and place (London) of sale. It is a well-known fact that Abbot, British-born like Alexander Wilson, had a correspondent in London who helped him sell his drawings and natural history collections. This was the "silversmith to royalty" and entomologist, John Francillon. In December, 1809, Francillon sold forty-four of Abbot's bird drawings to the Manchester Library (see Allen, 1951: 548).

The combination of evidence renders it safe to assume that it was John Abbot who collected these 93 species of birds from Georgia and Carolina. The type locality of *Aimophila aestivalis, Cistothorus stellaris,* and *Regulus regulus satrapa* may therefore be restricted to "Vicinity of Savannah, Georgia."

Most of these 130 specimens of historical value were still well preserved in the Zoological Museum of Berlin, when, on 3 February, 1945, three air bombs exploded in one of the halls of the ornithological department, destroying several thousands of mounted birds. A dozen or more of those which will henceforth remain connected with the venerable name of John Abbot fortunately escaped destruction. These include the types of *Aimophila aestivalis* and *Cistothorus stellaris* and a beautiful male Passenger Pigeon (*Ectopistes migratorius*). Of this pioneer's skill in dressing birds no other proofs are known to exist in the whole world.

SUMMARY

While staying in London in 1811, Friedrich Wilhelm Sieber, collector for the Count of Hoffmannsegg received, in exchange for Brazilian skins, 130 bird skins of 93 species from Georgia and Carolina. The following year they were deposited in the Zoological Museum of the Berlin University and immediately studied by Dr. Carl Illiger who named those which he believed new to science. From his MS notes the names *Fringilla* [*Aimophila*] *aestivalis*, *Troglodytes* [*Cistothorus*] *stellaris*, and *Regulus satrapa* were published in 1823, combined with technical descriptions. The types of the two first-named species are still preserved in the Zoological Museum, Berlin.

The collection had apparently been made about 1810 by John Abbot, who was at that time staying in Savannah, Georgia. Detailed evidence for this theory is presented. Other than those preserved in Berlin, no birds collected and stuffed by John Abbot are known to exist in any museum.

The type locality of *Aimophila aestivalis*, *Cistothorus stellaris*, and *Regulus regulus satrapa* may now be restricted to "Vicinity of Savannah, Georgia."

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Zoological Museum of the University, Berlin N 4, Germany, September 12, 1952.

RACIAL AND SEXUAL DIFFERENCES IN MIGRATION IN *SPHYRAPICUS VARIUS*

BY THOMAS R. HOWELL

THE subspecies of the Yellow-bellied Sapsucker (*Sphyrapicus varius*) are strongly characterized not only in morphology but in migratory habits as well. General outlines of the breeding ranges and winter ranges of the four subspecies are given in figures 1 and 2. These illustrate the well-known facts that *S. v. varius* is the most highly migratory of North American woodpeckers, *S. v. nuchalis* is moderately migratory, *S. v. daggetti* is still less so, and *S. v. ruber* is almost sedentary. Such racial differences in migration are by no means unique among polytypic species. In the course of investigating the ranges of these forms, however, I was struck by what seemed to be an unusually high proportion of female specimens of *S. v. varius* taken in the peripheral regions of its winter range. To determine if this apparent disproportion were real and if it extended to other races within the species, examination of a large series of specimens from all parts of the winter range of *Sphyrapicus varius* was necessary.

ACKNOWLEDGMENTS

I wish to extend sincere thanks to the following individuals for giving generously of their time and efforts in gathering data from the collections of their respective institutions: the late James L. Peters of the Museum of Comparative Zoology, Harvard University; Mr. Allan J. Duvall and Dr. Herbert Friedmann of the United States National Museum; Dr. John T. Zimmer of the American Museum of Natural History; Mr. Emmet R. Blake of the Chicago Natural History Museum; Dr. Robert W. Storer of the Museum of Zoology, University of Michigan; Dr. George H. Lowery, Jr., of the Museum of Zoology, Louisiana State University; Mr. Kenneth E. Parkes of the Laboratory of Ornithology, Cornell University; Dr. Dwain Warner of the Minnesota Museum of Natural History, University of Minnesota; Dr. Harrison B. Tordoff of the Natural History Museum, University of Kansas; Dr. James Bond of the Philadelphia Academy of Sciences; Dr. Robert T. Moore and Dr. John Davis of the Moore Laboratory of Zoology, Occidental College; Dr. Keith L. Dixon and Mr. Richard F. Johnston of the Museum of Vertebrate Zoology, University of California, Berkeley.

MATERIALS AND METHODS

Mimeographed forms were sent to the above-listed institutions requesting the sex, date, and locality of wintering specimens of *S. v.*

varius and *S. v. nuchalis*. Data on *S. v. daggetti* and *S. v. ruber* were also requested from the Museum of Vertebrate Zoology, and specimens of all four races were examined in the Dickey Collection, University of California, Los Angeles, and in the Los Angeles County Museum.

It was decided to include as "winter" specimens only those taken from November 1 through March 31, during which time populations would be relatively sedentary. A few birds taken in the early part of November or the latter part of March may have been migrants, but these dates are outside the time of main migratory movements and exclusion of all birds taken in early November or late March would probably eliminate many more winter residents than migrants from the data. All records for which the sex of the specimen or the date of collection was absent or questioned were discarded. Estimates of the significance of the data were determined by the chi-square method, and the customary value for chi-square of 3.841 or more was taken as an indication of significance. Adjusted chi-square values are given for samples of less than 200.

RESULTS

S. v. varius.—The number of winter specimens of each sex from the United States, Mexico, the Central American republics, and the West Indies are given in table 1.

TABLE 1

NUMBERS OF EACH SEX OF WINTER SPECIMENS OF *S. v. varius*. NO WINTER SPECIMENS FROM BRITISH HONDURAS WERE AVAILABLE

Locality	*Males*	*Females*
United States	126	100
Mexico	29	96
Guatemala	3	17
Honduras	0	6
Salvador	1	5
Nicaragua	0	1
Costa Rica	3	6
Panama	0	2
West Indies	11	30

The greater number of wintering females of *S. v. varius* from areas south of the United States is at once evident. Of the non-United States specimens, there are 164 females to 47 males, or approximately 77.5 per cent to 22.5 per cent (chi-square = 64.8). On the other hand, among winter specimens from the United States, males are more abundant—about 55.9 per cent to 44.1 per cent (chi-square = 3.0)—but the difference is not statistically significant.

As shown by the range maps, Middle America (including Mexico) and the West Indies form roughly an arc representing the periphery of the winter range of *S. v. varius*. It is arbitrary, of course, to fix a northern boundary for the peripheral part of the winter range at the Mexico-United States border, but the data indicate that this is not as unnatural as it might seem. Of 29 specimens from the eastern Mexico

FIGURE 1. Approximate outlines of breeding ranges of the four subspecies of *Sphyrapicus varius*.

border states of Coahuila, Nuevo León, and Tamaulipas, the only border states from which winter specimens of *S. v. varius* are available, 22 are females and 7 are males (chi-square = 6.7). Of 33 winter specimens from Texas, however, the proportion of males to females is almost exactly equal—16 males to 17 females. The Gulf of Mexico appears to form a natural gap between the rest of the United States and the Middle America-West Indies periphery. To check this

supposition, winter specimens from the Gulf Coast states of Texas, Louisiana, Alabama, Mississippi, and Florida were tabulated; the proportion of the sexes was 69 males to 50 females, which contrasts strongly with the much higher proportion of females to males from Middle America and the West Indies.

FIGURE 2. Approximate outlines of winter ranges of the four subspecies of *Sphyrapicus varius*. A few records for *S. v. nuchalis* mentioned in the text are outside the main winter range.

The disproportion of sexes in the peripheral areas of the winter range is significant if one assumes that the specimens represent a random sample of the wintering population over a period of many years. A spread of 92 years, from 1859 to 1951, was covered by the specimens examined. The year most abundantly represented was 1891, in which 23 out of 31 birds were females. The next most abundantly represented year was 1939, in which 14 out of 18 specimens

were females. It is evident, therefore, that the apparent disproportion of sexes among these wintering birds is not an artifact of sampling resulting from heavy collecting during unusual years.

It is also highly probable that the specimens from south of the United States represent a true random sample, for the two sexes of *S. v. varius*, although distinct, are not so strikingly different as to attract the attention of the collector to one or the other. The females are less brightly colored than the males and are, if anything, less conspicuous, and to my knowledge they are no more curious or less wary than the males.

At this point it may be asked why, if the disproportion of sexes is real, the ratio of females to males is not more or less exactly reversed in the northern part of the winter range? Although wintering male *S. v. varius* from the United States do outnumber the females, the difference falls short of statistical significance. One might expect instead that the males would outnumber the females by about 3½ to 1, since that is the ratio of females to males in more southern areas. A possible explanation may appropriately be offered at this point.

Many of the Middle American and West Indian specimens were taken by professional collectors who were paid by the specimen, or by museum parties wishing to get as large a series as possible in a short time; such collecting tends to be random and to produce a random sample if sufficient numbers are taken. On the other hand, collecting of a relatively common species in easily accessible areas in the United States may be more selective. A museum finding itself with 3 or 4 times as many males as females of *S. v. varius* from the United States might then attempt to acquire some more females to even up the representation of the sexes. Such a practice is especially prevalent in private collections, many of which have been incorporated into the collections of large institutions such as those which contributed to this survey.

This hypothesis on the lack of a more pronounced preponderance of wintering males from the United States is by no means definitive; it is merely offered as a plausible suggestion in the absence of conclusive evidence.

An alternative explanation would be that the total number of females in the entire population of the subspecies is consistently much greater than that of the males, at least in winter. There is no evidence, however, of a great surplus of female *S. v. varius* during the breeding season. One would have to propose, then, that more female than male young are produced, that most of these females migrate to the

periphery of the winter range, and that the surplus of females is somehow eliminated before the beginning of the breeding season.

To the present writer the first hypothesis seems much more reasonable than the alternate. It may then be proposed that the data indicate a sexual difference in the migration of this subspecies—that most of the females migrate to the periphery of the winter range whereas most of the males remain in more northern areas.

S. v. nuchalis.—Migration is much less extensive in this subspecies than in *S. v. varius*. *S. v. nuchalis* breeds as far south as southern New Mexico and southern Arizona, and it rarely winters south of central Mexico. Data were gathered on specimens collected in Mexico from November through March, and these showed approximately equal proportions of the sexes—36 males to 32 females. To determine if some peripheral disproportion of sexes might not be present on a minor scale, the specimens were further divided into those from the relatively northern areas of Coahuila, Chihuahua, Sonora, and Baja California north of latitude 30°, and those from the more southern areas of Yucatán, San Luís Potosí, Jalisco, Sinaloa, Durango, and Baja California south of latitude 30°. Of the northern group, the proportion was 30 males to 20 females (chi-square = 1.62), and in the southern group there were only 6 males to 12 females (chi-square = 1.4). Although these differences are not statistically significant, there is at least a suggestion that females are more abundant at the periphery of the winter range and that the proportions are reversed in the northern part, where males are in the majority.

S. v. daggetti.—Migration in this race is relatively slight and no real periphery of its winter range can be defined. However, since the Pacific Coast from the San Francisco Bay area south to northwestern Baja California represents the farthest limit to which any large part of the population moves, data were gathered from California museums on the proportions of the sexes from those areas. Specimens from Los Angeles County were excepted, since this coastal county is only a few miles from isolated breeding populations in the San Bernardino and San Jacinto mountains. Of 40 of these winter specimens of *S. v. daggetti*, 16 are males and 24 are females, and the difference is not statistically significant (chi-square = 1.2), although females are in the majority.

S. v. ruber.—Examples of this race normally do not winter outside some part of the breeding range of the subspecies. Only 10 winter specimens from the coasts of Alaska, British Columbia, Washington, and Oregon were available in three large California museums, and of these specimens 6 are males and 4 are females. Since this subspecies

is virtually non-migratory, no significant disproportion of sexes in wintering birds is to be expected.

DISCUSSION

Although sexual differences in extent of migration may not be confined to *Sphyrapicus varius*, discussion must necessarily be limited to that species. No broad generalizations can be made from the data presented here, but some implications of interest may be mentioned.

Observers have stated that males of *S. v. varius* arrive first on the breeding grounds in the spring (Merriam, 1879; Eaton, 1914). This may be the result not only of earlier migration but also of having generally less distance to cover than most of the females.

It has long been known that in the races of *Sphyrapicus varius* there is a curious inverse correlation between intensity of pigmentation and migratory tendency. *S. v. varius*, the least heavily-pigmented race, is highly migratory, and at the other extreme is *S. v. ruber*, of saturated pigmentation and virtually sedentary habits. The data presented here indicate that this inverse correlation seems to hold not only among the four subspecies but even in the males and females within each race. The female *S. v. varius* is less heavily pigmented than the male, and it appears certain that most females migrate farther than the males. In *S. v. nuchalis* the females are slightly less heavily pigmented than the males, and there is an indication although not a certainty that the former migrate farther. In *S. v. daggetti* there is only a faint indication of less pigmentation in the female, detectable chiefly as occasional white spotting in the outermost rectrices and in more frequent occurrence of a small white postocular spot in that sex, and in this subspecies a sexual difference in migration is completely or almost completely lacking. The pigmentation of the sexes is identical in *S. v. ruber*, and there is no evidence of a migratory difference. It should be recalled at this point that color differences between the sexes and races of *Sphyrapicus varius* are entirely quantitative, for all the variation is produced by greater or lesser deposition of red, yellow, and black pigments, particularly the first and last.

Evidence has been presented in a previous paper (Howell, 1952) that pigmentation in these sapsuckers is under genetic rather than endocrine control, and there can be little doubt that extensive, periodic migration has a genetic basis although the physiological stimulus for it may be an endocrine mechanism. In view of the correlation discussed above, the possibility of a common genetic influence on both pigmentation and migration merits consideration.

One suggestion is that sex-linked multiple factors, acting as modifiers, affect both intensity of pigmentation and extent of migration; in other words, they may act as pleiotropic genes. Possibly a genetically determined physiological process which results in heavier pigmentation may also represent a physiological adjustment which inhibits migration, and vice versa. Recalling that in birds the female is the heterogametic sex, one might suggest that these hypothetical modifiers are located on the X-chromosome, and that their effects are cumulative. Thus, a sufficient number of them on either one or a pair of X-chromosomes would result in maximum pigmentation and minimum migration in both sexes—i. e., *S. v. ruber*. If the number of modifiers were less, pigmentation would decrease and migration would increase. If a very few modifiers were present, the females, with only one X-chromosome, would express the effects more strongly, as in *S. v. varius*.

An alternative but related explanation is that different but closely associated alleles, influencing pigmentation and migration, respectively, compete with each other for a common and limited substrate with which they must interact for expression. Such a concept of gene action has been suggested by Stern (1943, 1949). This hypothesis could explain why intensity of pigmentation and extent of migration in the sapsuckers seem to increase at the expense of one another, and if the alleles were on the X-chromosome the differences between the sexes in these characters would also be explicable.

Previous investigators have pointed out correlations between pigmentation and other characters in birds. Maw (1935) concludes that plumage color and size are sex-linked characters in some domestic fowl, and Lee and Keeler (1951) mention numerous cases among birds in which pigmentation changes are correlated with variation in anatomy, physiology, and behavior. It is hardly necessary to emphasize, however, that the present discussion concerning sapsuckers represents a speculative approach to the data. Correlation does not necessarily mean common or even similar causality, of course, but the possibility that more than coincidence is involved is worthy of consideration until shown otherwise. Perhaps the sexual differences in migration herein described may be paralleled in other picids or other avian groups without regard to pigmentation. Members of the Picidae often show remarkable similarity in habits, and other species in this family may be found to exhibit tendencies like those of the sapsuckers discussed here. It is hoped that this paper may stimulate investigations leading toward more conclusive data on subjects of this nature.

SUMMARY

The four subspecies of *Sphyrapicus varius* differ markedly both in coloration and in migratory habits. *S. v. varius* is highly migratory, *S. v. nuchalis* is less so, *S. v. daggetti* is only slightly migratory, and *S. v. ruber* is practically sedentary. Data on wintering birds indicates that there are also differences in the extent of migration of males and females in *S. v. varius* and possibly in *S. v. nuchalis*. Among specimens from the southern part of the winter range (Mexico, the Central American republics, and the West Indies), females outnumber the males by about 3½ to 1, but in the United States winter specimens of males are in the majority. In *S. v. nuchalis*, wintering females are in the majority in the southern part of the range and males outnumber females in the northern part although the differences fall short of statistical significance. *S. v. daggetti* and *S. v. ruber* do not show comparable phenomena. There is a curious inverse correlation between extent of migration and saturation of pigmentation not only among the races but among the two sexes within the races. Possible genetic linkage of factors affecting pigmentation and migration is discussed.

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THE HISTORY, BEHAVIOR, AND BREEDING BIOLOGY OF THE ST. KILDA WREN

By Edward A. Armstrong

The island group of St. Kilda lies about fifty miles west of the Sound of Harris in the Outer Hebrides and consists of Hirta or St. Kilda proper (1575 acres), Soay (244 acres), and Dún (79 acres), lying close together, with Boreray (190 acres) and huge rock stacks, Stac an Arnim and Stac Lee, some four miles to the northeast. All the islands are precipitous and the sheer cliff of Conachair (1200 feet) on Hirta is the highest in the British Isles. The village on Hirta was inhabited for hundreds of years until 1930 when the few remaining islanders were evacuated. Although the romantic interest of St. Kilda stimulated many visitors to record their impressions, only desultory observations of the St. Kilda Wren (*Troglodytes troglodytes hirtensis*) were made before the evacuation. As transport is difficult to arrange and there are days when landing is impossible, no ornithologist has been able to make a thorough study of the bird. Moreover, the advanced dilapidation of the abandoned cottages in which visiting naturalists used to stay renders conditions more difficult. This situation forms some justification for a review of the main facts of the life history of the St. Kilda Wren, although the writer's stay on Hirta lasted only seven hours.

Appearance and General Behavior

In the field, the upper-parts of St. Kilda Wrens look grayer and their under-parts look paler than those of European Wrens (*Troglodytes t. troglodytes*). St. Kilda Wrens are less ruddy than the latter, though Harrisson and Buchan (1936) remark that dark birds have a more rufous appearance than pale individuals. Commenting on the difference in appearance between birds they say (p. 19) that "evidence for dimorphism similar to that in the mainland wren, is strong." There is a certain amount of variation among European Wrens in Britain, but it could not be called dimorphism. Indeed, to call St. Kilda Wrens dimorphic is rather misleading as there are intermediates, though they can be roughly denominated "light" and "dark." The conspicuous dark barring on the mantle of some birds is particularly distinctive. Dresser (1886: 44) minimized the importance of the stoutness and length of the St. Kilda Wren's bill as diagnostic characters, yet even in the field close observation reveals that the bill of this race is stronger than the bill of the European Wren. Modification of the bill is characteristic of the insular subspecies of the North Atlantic

and North Pacific. Thus, *T. t. islandicus* and *T. t. zetlandicus* have stronger bills than *T. t. troglodytes;* and, in the Pacific, *T. t. tanagaensis* and *T. t. semidiensis* have relatively long bills (Oberholser, 1919: 231, 234).

St. Kilda Wrens constantly work along the walls in the village and pass in and out of chinks in the "cleits"—oval, stone structures in which the villagers used to store carcasses of birds, etc. On cliffs they take *Machilis* and tipulids, and feed among nesting Fulmars (*Fulmarus glacialis*) and Puffins (*Fratercula arctica*).

Like European Wrens, the wrens of St. Kilda occasionally sun-bathe. The molt occurs from early August until well into September (Clarke, 1915; Harrisson and Buchan, 1936).

Most of those who have studied the St. Kilda Wren record that it is tamer than the European Wren in Britain. The St. Kilda birds are more tolerant of observers near the nest. The males of several, if not most, races are apt to seem more timid than their mates, but it is difficult to compare the timidity of the sexes at the nest as it is bound up with the relative strengths of the drive to feed the nestlings, which in some races is weaker in the males. Away from the nest I found that birds, when disturbed, tended to fly out of sight. My impression was that they were not quite so bold as Shetland Wrens (*T. t. zetlandicus*), but were somewhat more tolerant of the presence of a human observer than Hebridean Wrens (*T. t. hebridensis*). There is no reason to think that either the period of "persecution" or the subsequent interval during which the wrens have seldom seen a human being has made any difference to their reactions to mankind.

History and Population

T. troglodytes is the only species of wren in Eurasia and is evidently a comparatively recent immigrant from the New World. It may have reached Asia by the Bering Straits land-bridge no earlier than the Pleistocene (Mayr, 1946; and *in litt.*). If it were known that during any phase of the Ice Age, conditions were too extreme on St. Kilda for the wren to survive, it would be possible to infer the approximate period which has been required for subspeciation. Unfortunately the extent to which there may have been refugia in Britain is still in dispute, though the evidence for such in the Western Isles is increasing. The available data suggest that St. Kilda may have remained ice-free. Turrill (1927) says that the flora of St. Kilda is much as it was in late Pliocene times and that it survived the Ice Age *in situ*. The climate has been milder than it is now, for examination

of the peat has disclosed pollen of birch, pine, alder, hazel, and willow (Poore and Robertson, 1949). As a wren habitat it must have approximated country favored by the European Wren more than at present, for trees do not now grow there. Conditions are probably similar to those prevailing on some of the North Pacific islands where wrens are found.

The wren was mentioned as one of the birds of St. Kilda by Martin (1698) and Macaulay (1764). Mackenzie (1905), publishing notes made by his father, who was on the islands from 1829 to 1843, refers to the wrens as resident. Apparently A. G. More was the first to suspect that the wren might be distinctive, but Barrington (1884) failed to obtain specimens and it was left for Dixon to bring back skins from which Seebohm (1884) described the bird as a new species. After Dresser (1886) had criticized its being given this status it was reduced to subspecific rank.

The recognition of the St. Kilda Wren as distinct inaugurated a period during which skins and eggs were sought by museums and collectors. Soon the cry was raised that its extinction was imminent. The outcome was the passing of "The Wild Birds Protection (St. Kilda) Amendment Bill, 1904" providing legislative protection for the St. Kilda Wren and Leach's Petrel (*Oceanodroma leucorhoa*). Thus the St. Kilda Wren played a part in stimulating the campaign which has gradually resulted in the more adequate conservation of British wildlife. It is curious that this should be so, as in the interests of the foraging activities of the islanders, who lived largely on the birds and their eggs, St. Kilda had been expressly omitted from the Wild Birds Protection Act of 1880.

So vehemently did the protectionists advocate, and sometimes exaggerate, their case that it has been erroneously assumed, and is still believed, that the St. Kilda Wren narrowly escaped extermination. As long ago as 1884, however, Barrington, who had climbed cliffs on St. Kilda, said of the wren (p. 384): "It would take some of the best cragsmen in the Alpine Club to extirpate it." Two myths became established—that the wren had nearly become extinct and that legislation had saved it. Harrisson and Buchan (1934: 134) remarked that "in 1888 the wren was almost extinct." Apparently they accepted at its face value the statement of Harvie-Brown and Buckley (1888: 56) that the bird "appears to have become almost extinct." They omitted to take account of Harvie-Brown's later admission (1902: 143) that these remarks "were perhaps somewhat premature." The climax was reached when Hudson (1894: 31) exterminated the wren with his pen, remarking that as a result of the

invasion of the islands by collectors "the St. Kilda Wren no longer exists."

Elliott (1895), perhaps influenced by these dismal stories, estimated the total wren population to be fifteen pairs, but as he found three occupied nests—amounting to twenty per cent of the supposed population—the unreliability of his estimate is apparent. Lowe (1934) remarked that the bird nearly became "an interesting memory," and as recently as 1947 an anonymous writer in 'British Birds' referred to the traffic in skins and eggs as having threatened the wren with extinction. Fisher (1948a, 1951: 30) pointed out that such opinions were exaggerated but wrote: "There is no doubt that until well into the present century the wrens were raided, and became rare in the accessible parts of the islands, particularly round the village of Hirta." Even this statement goes beyond the facts.

In 1896 Harvie-Brown (1902) noted wrens close to the village and Dixon (1885a, 1888, 1898) found the bird common in 1884. Kearton (1897) was impressed on landing by their joyous songs. Heathcote (1900), who explored the islands thoroughly in 1898 and 1899, stated that they were to be heard "in all parts." In 1910 and 1911 Clarke (1915) found wrens abundant in the village and elsewhere, and the Duchess of Bedford (1914: 174) noticed several "about the houses and cleits."

Harrisson and Buchan (1934: 134) referred to the legislation of 1904 being "just in time to save the remnant" and Gardiner (*in* Hudson, 1923: vi) thought it gave the bird "a new lease of life," but it may have had the opposite effect by increasing the "black market" value of the eggs and thus stimulating the ardor of collectors and the cupidity of the islanders. Fisher (1948a) mentioned a dealer who took birds and eggs in 1907 and solicited subscribers for another collecting trip in 1908. A collector, Whitaker (*unpubl.*), saw a nest in 1927 which had already been robbed; Lowe (1934), who visited the islands in 1929, remarked that high prices were paid for eggs. Harrisson and Buchan (1934: 135) referred to "a dozen or so nests" being robbed annually and mentioned £5 as the value of a clutch. Evidently the Act of 1904 was honored more in the breach than the observance.

It might seem that human predation on the scale of a dozen nests robbed annually would reduce the population seriously but, although the nest-record cards of the British Trust for Ornithology show that about one-third of the nests of European Wrens come to grief, it remains a common bird. Apparently St. Kilda Wrens re-nest after being robbed (Lowe, 1934:98) so that the loss of a clutch does not mean that the birds will not rear young that season. Harrisson and Buchan

(1934: 137) estimated that about 82 per cent inhabited cliffs. Few nests in such places would be robbed. Moreover St. Kilda must have been inhabited by wrens before the building of the village, which provided additional nesting-places for them, so that we need not suppose that the elimination of the whole village population annually would have extirpated the bird. The ten skins in the Royal Scottish Museum apparently constitute the largest set in any collection. It is highly improbable that as many as 100 were obtained in 50 years.

It has been maintained that "there is no reason to suppose that any significant change in numbers has occurred" (Nicholson and Fisher, 1940: 31) and that the population remains "remarkably constant" (Fisher, 1948a, 1951: 31), but there is evidence that numbers fluctuate.

In 1883 Barrington (1884: 284) "only came across it six times in three weeks." Dixon, as we have noted, found the wren common in 1884, but J. T. Mackenzie who spent a fortnight on St. Kilda in that and the subsequent year reported that in 1885 the birds were "not nearly so numerous" (Dixon, 1885b). This was before they were persecuted. The geologist Cockburn (*in* Harrisson and Buchan, 1934: 135), who was on the islands for some months during 1927 and 1928, roughly assessed the population at under 100 pairs. Later estimates are tabulated below:

TABLE 1

ESTIMATED NUMBERS OF PAIRS OF ST. KILDA WRENS

Island	(*Harrisson and Lack, 1934*)	(*Nicholson and Fisher, 1940*)
Hirta	45	31
Dún	11	12
Soay	9	
Boreray	3 (?)	5 +

Mr. I. J. Ferguson-Lees (*in litt.*) found about 48 pairs on Hirta and 14 or 15 on Dún in 1948. Owing to the difficulties in estimating the number of wrens on the cliffs, all observers admit that allowance has to be made for a margin of error.

Around whatever figure the wren population on St. Kilda may vary, the number of pairs of the Fair Isle Wren (*T. t. fridariensis*), reckoned in 1951 to be between 30 and 40, is probably fewer (Williamson, 1951a, b). In such small populations evolution may be rapid.

Contrary to the situation in most other regions of St. Kilda it is comparatively easy to estimate numbers in the compact area of the village, and the margin of error in most of the estimates is unlikely to be more than one pair.

TABLE 2

ESTIMATED NUMBER OF PAIRS OF ST. KILDA WRENS IN THE VILLAGE ON HIRTA

Authority	*Year of Census*	*Number*
Harrisson and Lack, 1934	1931	8
Harrisson and Buchan, 1934	1931	12
Atkinson, *in litt.*	1938	12
Nicholson and Fisher, 1940	1939	12
Fisher, 1948b	1947	10
Ferguson-Lees, *in litt.*	1948	11
Fisher, *in litt.*	1949	10
Armstrong and Westall	1951	10

It will be noted that the two estimates for 1931 do not agree. The 1938 figure is based on a count late in the season of the number of nests used or in use and may be slightly over-estimated. Perhaps the count by Armstrong and Westall is one too many. Further details regarding the village wrens and the behavior of the birds will be discussed elsewhere (Ferguson-Lees, Fisher, and Armstrong, *unpubl.*).

Fisher based his opinion that the total population of the St. Kilda Wren remains constant on the stability of the breeding population in the village. He wrote (1948b): "We have found evidence from the village sample that the population has not changed in sixteen years." Unfortunately such generalization is unreliable. In seasons when numbers of the European Wren are low one notices that the birds concentrate on the most favorable localities, leaving untenanted the "marginal" areas which are only occupied in peak years (Armstrong, *in press*). Almost certainly this applies to St. Kilda. Thus a census of the favorable area of the village does not provide an accurate index of the total population. The slopes behind the village constitute a "marginal" area, and as the numbers there vary we have positive evidence of fluctuations in population. Harrisson and Buchan (1934) said they found no wrens on the village slopes or anywhere inland in 1931, though reference is made to a brood fledging from a nest in the glen—which is an inland area (Harrisson and Lack, 1934). Whitaker (*unpubl.*) found an old and a new nest there in 1927. Four male wrens were noted on the slopes in 1947. Fisher (1948b) remarked that this year was apparently their first nesting there and in the glen, but he has since called my attention to a reference mentioning a nest in 1886 "on the shoulder of Connaker" (Newton, 1902: 264). It is unlikely, however, that this refers to the village slopes. Ferguson-Lees observed 14 pairs on the slopes in 1948, but in 1951, Dr. Westall and I found none there. It is improbable that the wrens vacated the

cliffs in favor of the slopes. In 1948 Ferguson-Lees found 14 or 15 pairs on Dún, where numbers are comparatively easy to assess. Only 11 pairs were noted in 1931. These data provide further evidence of fluctuations in total population.

That the St. Kilda Wren population should be variable is not surprising in view of what is known of other races. The European, Shetland and Alaska wrens fluctuate in numbers (Armstrong, *in press*, 1952; Nelson, 1887: 210) and probably also the Iceland Wren (*T. t. islandicus*) (Armstrong, 1950a). Gudmundsson (1951) suggested that this race has become commoner with the amelioration of the climate, but there is insufficient evidence to prove this.

HABITAT

The wren breeds on the major islands, mainly where the vegetation is comparatively lush on steep slopes, cliffs, and the damp area near the village. Barrington (1884) flushed one from a crevice 300–400 feet down the cliff of Conachair, and in 1884 Dixon found wrens on the hills and cliffs as well as in the village. Clarke (1915) was told that the wren occurred on Stac an Arnim, the gaunt, gannet-frequented, 627-foot crag which rises like a huge tooth from the sea off Boreray, but he did not state, as Harrisson and Buchan (1934) said that he did, that it bred there. Like the Hebridean and Shetland wrens, the St. Kilda Wren particularly favors places where moisture and fertile soil stimulate rich vegetation harboring numerous insects. The habitats it prefers resemble those chosen by Faeroe Wrens (*T. t. borealis*) (Williamson, 1948), but differ from the areas favored by Iceland Wrens. These are mainly regions of birch scrub (Timmermann, 1949). There is an interesting relationship, most conspicuous on Dún, between the populations of wrens and Puffins, and estimates indicate a pair of wrens to about every five to seven acres—a density greater than that noted elsewhere in the islands with the exception of Village Bay, where streams, marshy, coarse herbage, and the varied rank vegetation which grows around the houses, cleits, walls, and shore provide excellent foraging for the wrens in spite of grazing by Soay sheep. Dún is one vast puffinry, inhabited by thousands of birds, and the abundant guano fertilizes the soil so that there is a characteristic zooplethismic vegetation and a variety of scatophagous insects (Lack, 1932a, b). Thus, for example, *Rumex acetosus* grows to a height of two to three feet (Petch, 1933; Poore and Robertson, 1949). Harrisson and Buchan's figures show that there were about twice as many wrens on the puffin slopes as on the steep cliffs. These writers

stated that the areas unfavorable to wrens are low or sheer cliffs near sea-level and homogeneous grass slopes. Thus, like other races, the St. Kilda Wren tends to avoid areas with scanty vegetation or where the ground is dominated by a few low-growing species.

TERRITORY

Dixon (1888) stated that year after year the St. Kilda wren is found in favorable localities, and this is borne out by later observers. Harrisson and Buchan (1934) estimated the average distance between pairs in the village as slightly over 90 yards, with a variation between 70 and 200. I found no bird more than 200 yards, or less than 90 yards, from his nearest neighbor. The males were fairly evenly spaced so that if one assumed each bird's territory to consist of a circular area around his singing point the radius of the circle would be some 75 to 100 yards. This would indicate territories of the order of about 17,000 to 30,000 square yards—more than four times larger than the previous highest estimate. Harrisson and Buchan computed that the village territories averaged 3000 to 5000 square yards and Ferguson-Lees' estimate is 3500 square yards. The singing male in the center of the village was surrounded by five neighbors. The distances of their singing stances were respectively, 200, 200, 200, 185, and 150 yards, giving a circular area around the central bird of some 26,000 square yards, if we suppose half the average distance to the stations of the males to represent the radius of the territory. This calculation, and others on a similar basis, would not be seriously erroneous unless there were extensive neutral areas between territories. No doubt small neutral or disputed areas exist and perhaps we may assume that near the peripheries of territories defense tends to diminish in vehemence, but it is improbable that large areas of "no-man's-land" exist in a congested area where a wren is surrounded on all sides by rivals. As the neutral areas established by the European Wren are not very extensive relative to the size of the territory, it is so much the less likely that the St. Kilda Wren differs in this respect. Making allowance for such neutral areas I believe that the wrens I observed in the village area held territories of not less than 15,000 square yards. Some were probably considerably larger.

Along the cliffs Harrisson and Buchan (1934: 138) estimated that 21 out of 33 pairs were between 150 and 300 yards apart. The rest were separated by distances from 300 to 450 yards. Shetland Wrens on low cliffs and Hebridean Wrens on a ridge tend to be about 250 yards from one another (Armstrong, 1952, 1953). Heath's data (1920)

suggest that an Alaska Wren's territory may extend for about a quarter of a mile along the coast. Harrisson and Buchan (1934: 139) stated that the "range" of each pair abutted directly on that of the next, but "there was usually a neutral zone and a certain amount of overlap." This rather inconsistent statement can best be interpreted as indicating that when birds are feeding nestlings the territorial boundaries are not rigidly maintained. Observations by Ferguson-Lees show that at this stage males may defend no more than a radius of 12 yards around the nest. He found an overlap of foraging areas of two pairs nesting 50 yards apart to within about 12 yards of each nest. R. Atkinson (*in litt.*) also noted intrusion to within a few yards of a nest with young. Such diminution of territorialism when nestlings are being fed is frequent among passerines but is modified among European Wrens by various forms of behavior associated with polygamy. Reduction in song and sexual and territorial activity is correlated with increasing concern for the nestlings in all races of *T. troglodytes* which have been studied. In general, sexual and territorial activity are in inverse ratio to domestic activity.

Probably when Harrisson and Buchan, and later, Ferguson-Lees, made their estimates in July and August, territorialism had become subordinated to caring for the young and not only had the area defended diminished, but defensive manifestations had decreased and become less conspicuous. My estimate was made near dawn on June 13 when breeding activity was beginning—the times of day and year when singing and territorialism are at their maximum. Thus it seems that when breeding starts, the territories are comparable in size with those of European Wrens in garden-woodland surroundings (Armstrong, *in press*) or even larger, but as the needs of the nestlings make increasing demands on the energy of the males the territories tend to contract and their boundaries become vague.

THE CONCEPT OF "FOOD TERRITORIES"

On the basis of their study of one pair, Harrisson and Buchan came to the conclusion that the St. Kilda Wren's territory is divided into subterritories where food is obtained. They state (1934: 144): "Food territories are further divided into sex territories, each parent tending to feed in exclusive patches not used by the other." As it is of the essence of territory to be defended (Armstrong, 1947: 271–292), and since no evidence of this was found in regard to these individual foraging areas which Harrisson and Buchan styled "a new type of territory," the term should not be used in connection with them. No

other observer has found evidence of foraging areas peculiar to one or the other of the pair. Shetland Wrens nest in habitats very similar to those chosen by St. Kilda Wrens. The birds of a pair forage independently and are apt to pay a number of successive visits to particular patches of rich vegetation (Armstrong, 1952). Superficial observation might suggest that these were exclusive foraging areas, but persistent study showed that neither bird claimed proprietary rights over the other in any area. Occasionally they could be seen foraging only a few yards from each other. When both male and female European Wrens feed the nestlings, their behavior is very similar, and the male Hebridean Wren seldom forages near the female. Miller (1941: 85) has shown that early in the year the male Bewick Wren (*Thryomanes bewickii spilurus*) feeds in a higher zone of the vegetation than his mate. This is true to some extent of European Wrens and may decrease competition for food, but these feeding zones should not be described as sexual food territories.

Harrisson and Buchan suggested that much of the territory is virtually unused for foraging. They estimate that the pair they watched obtained 95 per cent of the food for themselves and their nestlings in one per cent of the territory. They do not state, however, on how many hours' watching this estimate is based. St. Kilda Wrens, when feeding nestlings, act as do the other races in which such behavior has been studied—spending most of their time foraging in patches of rank vegetation and avoiding areas of short turf and homogeneous herbage. The observations of Harrisson and Buchan, however, raise an important issue which merits comment.

Evidence is accumulating to show that family size in birds is closely related to the expenditure of time and energy in foraging. It is the availability of food and not merely its presence which is relevant. Whatever importance a territory may possess as a foraging area is dependent on the food's being obtainable without an uneconomical expenditure of time and energy. If the feeding areas in a territory were all at the periphery, so much time would be occupied in fetching food that the nestlings might be undernourished. Moreover, a territory might contain adequate food and yet, if prey were difficult to find or the organisms very small, it might be impossible for the birds to rear young. The much-debated question of the food value of nesting territory will not be decided by considering whether or not the birds forage throughout the whole territory. A very large territory might be essential to the successful reproduction of a pair of birds because scattered widely in it were a few comparatively rich areas where food could be obtained expeditiously. Thus Harrisson and

Buchan noted that wrens were never seen feeding in arable grassland. Undoubtedly arthropod prey is to be found there, but its value is apparently sometimes so low that it is not worth the time consumed in foraging for it. Lack (1932a: 262) stated that sweeping for diptera "in the thick vegetation of the formerly cultivated area around the village and in a small marsh just outside this area was particularly remunerative." He also mentioned (1931) that the terrestrial fauna is poor as regards both species and individuals. So far as species are concerned this is borne out by Edwards and Collin (1932).

Referring to the autumn dispersal to non-breeding areas Harrisson and Buchan remarked that, as birds are found in late summer and autumn in these areas, scarcity of food cannot be the primary reason wrens do not choose them for nesting. This is obviously fallacious since transient individuals could subsist for a time where families could not be reared.

The diminution in territorialism among birds feeding nestlings is a consequence of the fact that defensive activities are a dissipation of time and energy at this stage. If at the beginning of the breeding season a number of birds so divide up an area that there will subsequently be sufficient food for the family in each domain, it does not matter whether the boundaries later become indefinite and defense of the territories breaks down. What is essential is that the species should be equipped with inherited behavior-patterns, related to the establishment of territory, such that when the time for feeding the nestlings arrives there will be, in normal seasons, an adequate and sufficiently available food supply.

SONG

I was able to hear the songs of St. Kilda, Hebridean, and European wrens (in Scotland and England) on three successive days and was impressed by the points of difference between them. The Hebridean Wren's phrase, with its "reel," is the most distinctive of the songs I have heard. In the St. Kilda Wren's song there is often only one trill, but sometimes in a longer phrase there may be two. Preceding the trill the notes frolic up and down in a brief, pleasant warble. The song is more musical, less mechanical, and less shrill than that of the European Wren. In spite of the statements of several observers, including Mr. James Fisher, to the contrary, Ferguson-Lees, Westall, and the writer are convinced that the song is no louder than that of *T. t. troglodytes*. Possibly it is softer. The rocky background amplifies the sound so that birds can be heard singing at a distance of half a mile and, no doubt, under good conditions considerably further.

Harrisson and Buchan (1936) were incorrect in stating that the average duration of the phrase is 20 seconds. Kearton (1897) reckoned it correctly at five to six seconds. A bird in ardent song, whose mate was at the stage of nest-lining, timed for five successive minutes sang, 6, 5, 4, 5, and 5 songs. This rhythm with songs and intervals of the order of about five seconds approximates that of other European races. Another bird, singing less consistently, uttered phrases lasting 5, 3, and 3 seconds, with pauses of 6, 5, and 11 seconds. Occasional songs of as long as eight seconds were noted. Counter-singing occurs, two birds regularly alternating their phrases; this also occurs in the mainland race (Armstrong, 1944). As with other races the duration of the phrase is modified when the bird is excited by the presence of a female; it may then be either extended or abbreviated.

Probably song begins about civil twilight—when the sun is 6° below the horizon. When the writer landed at 2:42 G. M. T. the birds were in full song. While search was being made for the landing-place in the dim light of a foggy daybreak, the songs of wrens from the deserted village, heard above the crash of the breakers on the cliffs, served as clues to our position. By 4:00 there was a marked diminution of song and several birds seemed to have ceased, or almost ceased, singing; by 9:30 only two or three of the ten males in the village were noticeably vocal. This experience during the season of the year when song is at its peak suggests a source of inaccuracy in censuses, especially on the cliffs, taken later in the season and several hours after dawn when most counts were made. Harrisson and Buchan (1936) heard no birds on the cliffs during the last few days of July; and for several days at the beginning of August, despite careful observation, not a single song was heard in the village. The molt had begun.

Like the European Wren, the St. Kilda Wren sings with his tail cocked when excited, but by no means always. Flight-song is fairly frequent and has been noted in June, July, and August. Probably all races of *T. troglodytes* sing in flight, but flight-song may be particularly characteristic of those inhabiting relatively open habitats (Armstrong, 1953, *in press*).

DISPLAY

The little which has been observed of the epigamic display indicates that it is substantially similar to the displays of other races (Armstrong, *in press*). Ferguson-Lees saw a bird posture with drooping wings and spread tail while singing a snatch. Harrisson and Buchan (1936: 16) noticed alarmed birds "quickly running around on rocks and stones with fluttering wings" and regarded this behavior, probably correctly,

as "a modified sexual attitude." Perhaps it might also be considered an incipient distraction display. Nice and Thomas (1948: 152) noted a form of impeded flight by a Carolina Wren (*Thryothorus ludovicianus*), which they regard as distraction display, but no quite definite form of distraction display has been recorded in the Troglodytidae. Displays of related character by various species reinforce the view that some forms of distraction display are modifications of epigamic posturing originating as displacement activities (Armstrong, 1949, 1950b).

Atkinson (1949: 256 and *in litt.*) noticed that on one occasion when both birds arrived together at the nest, one "greeted the other by spreading and vibrating its wings and making queer little chipping noises." He also saw a single bird, clinging to the nest, display in this way. Judging by analogous displays, this performance probably had a sexual basis but may have been stimulated or accentuated in displacement fashion by the presence of the photographer and his hide. Somewhat similar displays are seen when Hebridean or Shetland wrens are together near the nest, and I have known a European Wren to display while holding food in front of the nest while I was in a hide close by.

PAIR-BOND

About fifty per cent of the European Wren population in garden-woodland areas of Holland and England are polygamous (Kluijver *et al.*, 1940; Armstrong, *in press*), but the St. Kilda race is monogamous. The low development of multiple nest-building is consistent with monogamy and inconsistent with polygamy. Moreover, all observers who have studied the activities at nests with young have noted both parents feeding them; but the female European Wren is often left to tend the nestlings unaided. The evidence suggests that the male St. Kilda Wren may even exceed the assiduous male Shetland Wren in his concern for the nestlings. As there are records of Eastern and Western Winter Wren nestlings (*T. t. hiemalis* and *T. t. pacificus*) being fed by one parent (Stanwood *in* Bent, 1948; Grinnell and Storer, 1924) and multiple nest-building is characteristic of both races (Bent, 1948: 151; Bowles, 1899), it is highly probable that they also tend to be polygamous. Both parents fed the young at a July nest in Maine (Cruickshank, 1951), but the male European Wren frequently helps feed the nestlings late in the season when his sexual drive has weakened; doubtless this is true of the Winter Wren also. On the other hand *T. t. zetlandicus* is predominantly monogamous and so, probably, is *T. t. alascensis*, for Heath (1920) noticed that the male is diligent in

feeding nestlings. Thus it appears that the wrens in bleak, northern insular habitats tend to be monogamous while those of southern "continental" habitats incline to polygamy. The principle involved is discussed later in this paper and also elsewhere (1952, and *in press*).

NEST-BUILDING

The nest is built by the male, as in all races which have been studied, although exceptionally female European Wrens may build. Heath (1920) was mistaken in assuming that the female Alaska Wren makes the nest. On the whole, the nest of the St. Kilda Wren is more crudely constructed than the nests of *T. t. islandicus* (Armstrong, 1950c), *T. t. zetlandicus*, *T. t. hebridensis*, and *T. t. troglodytes*. Judging by published descriptions it is also often less well fashioned than the nests of *T. t. mülleri*, *T. t. kabylorum*, *T. t. hiemalis*, *T. t. alascensis*, and other races for which details are available. Many are built rather loosely of coarse grass and tend to be bulkier and to have wider apertures than do nests of European Wrens (Kearton, 1897). Others in cleits or other cramped cavities consist of a shell or cup of vegetable material, mainly moss. They are frequently well concealed. Perhaps the crudity of many nests is due more to the use of recalcitrant materials than to lack of craftsmanship for Dixon (1898) saw nests which he spoke of as being beautifully made of moss with the threshold strengthened with grass stalks.

In the village area the nests are in cleits, dilapidated cottages, and stone byres, many of which were used as dwellings before the cottages were built about the middle of last century. The nesting sites are commonly over, or quite near to, the low entrance of the cleits. The very small area of shingle bank near the beach is also chosen for nesting (Harrisson and Buchan, 1936; Lowe, 1934). Harrisson and Buchan (1936: 11) remark that "the entrance holes seem to have been burrowed in the earth, as was a nest seen by Eagle Clarke," but they have misinterpreted his comment (1915) which is that a nest "was built in a cavity in a mass of dead thrift on the face of a cliff." In spite of Lowe's remark about seeing a nest in a hole such as might have been made by a rat (although, as he points out, there are no rats on St. Kilda) evidence is lacking that the St. Kilda Wren ever enlarges an earth cavity by excavation. Bank nests are often sheltered by tufts of coarse herbage.

The nest is usually constructed of material available quite close at hand. Withered grass is commonly used and is probably collected when damp and most pliable. Nests in cleits are often built of hay found inside the cleit. Like other races, *T. t. hirtensis* adapts the nest

to the site, sometimes shaping grasses into a rough ball and on other occasions packing material into a cavity to create a soft recess to receive the eggs. Old nests are sometimes refurbished and used again, and Lowe reported finding a nest in a cavity from which a nest and eggs had been removed earlier in the season.

The St. Kilda Wren builds fewer nests than the European Wren (Atkinson, 1949) which averages about six and may build ten or a dozen (Kluijver *et al.*, 1940; Armstrong, *in press*). Ferguson-Lees (*in litt.*) estimated that in July, 1948, there were less than three nests to every two pairs. He noticed a male, whose young had fledged, engaged in building. Iceland Wrens build as late as June 28 (L. S. V. Venables, *in litt.*), European Wrens up to the end of July, and Kashmir Wrens (*T. t. neglectus*) in the first week of August (Bates and Lowther, 1952). These late nests can seldom be used for breeding. Harrisson and Buchan's remarks are confused and misleading for they speak of "cock's nests" being used for breeding whereas a "cock's nest" is merely one of a series—often unfinished—which has not been chosen by a female. Fisher's references (1948a; 1951: 30) to some "nests probably made by the cocks" should not be regarded as indicating that others are built by the females.

NEST-LINING

Lining with feathers or other soft material is performed by the female when she has chosen a nest. Most used nests contain some Fulmar feathers and emanate the characteristic musky smell. Puffin, Starling (*Sturnus vulgaris*), Hooded Crow (*Corvus cornix*), and Snipe (*Capella gallinago*) feathers have also been recorded. Dixon (1885a) commented that the nest is abundantly lined with feathers, but European Wrens' nests often contain more, but smaller feathers. Harrisson and Buchan (1936) counted 35 feathers from a St. Kilda nest, whereas Marples (1935) noted that a European Wren's nest contained 498. Dixon (1888) remarked that the wrens used to steal hair from the Puffin snares set by the islanders.

EGGS

The eggs are noticeably larger than those of *T. t. troglodytes*, averaging 18.55 by 13.93 mm. (Jourdain, *in* Witherby *et al.*, 1938: 217), and are marked with rufous spots similar to those on the eggs of the European Wren. Immaculate, or almost immaculate, single eggs and clutches occur (Seebohm, 1885; Dixon, 1888; Elliott, 1895; Whitaker, *unpubl.*). As pointed out elsewhere (Armstrong, 1950a) spotless eggs appear to be commoner among northern insular races than in *T. t.*

troglodytes. Perhaps this is correlated with the presence of fewer mammalian egg-predators. Thus eggs of the Alaska and Aleutian wrens (*T. t. alascensis* and *T. t. meligerus*) are sometimes without markings (Bent, 1948; Turner, 1886: 181). Jourdain stated that the clutch is four to six with seven occasionally, but this maximum must be very rare as the Factor on St. Kilda, who had seen some 50 nests, told Kearton (1897) that none contained more than six. The average clutch-size is evidently smaller than that of the European Wren, and the evidence is consistent with, though insufficient to prove, a reduction in clutch-size late in the season.

BREEDING SEASON

Many observers have speculated as to the period of breeding and the occurrence of second broods. Analysis of the data available from all sources indicates that the main laying period lies from the last week of May until about mid-June, with the peak probably early in June, but there is seasonal variation of about a fortnight and apparently a greater "spread" of nesting than is usual among insectivorous birds of temperate regions. It is exceptional for young to fledge earlier than the last fortnight in June. Such second brood clutches as occur would therefore appear about the first fortnight of July. As there is so little evidence of nests with eggs during this period, second broods cannot be usual. Nest predation does not seem to be sufficiently severe for more than a few of the late nests to be considered as replacements, so it would seem that the St. Kilda Wren, like the Shetland race, tends to spread its nesting and to rear comparatively few second broods.

NESTLING PERIOD

Neither the incubation nor the nestling period is known. The only records of the feeding rhythm are those of Harrisson and Buchan (1936). They stated that during the first week the young are fed on the average 150 times a day and that this is equivalent to about 40 feedings per chick. They speak of 10 to 13 feedings per hour at nests where both parents were active. Such a tempo may be far exceeded by a single European Wren. A female made just over 360 visits to five young on their fifth day and 560 to four chicks when they were sixteen days old (Whitehouse and Armstrong, *in press*).

Harrisson and Buchan considered that the share of the sexes is about equal though some of their observations suggest that at one nest the male was most active. Atkinson (*in litt.*) noticed that the day before fledging the male did most of the feeding. In any race of

wren this is unusual although it sometimes occurs among tits (Hinde, 1952). Atkinson also observed that both parents brooded a family which fledged four days later. Such brooding of well-grown young is remarkable; that a male should take part is incomprehensible. Perhaps he was taking refuge in the nest rather than brooding. Behavior of this kind has not been recorded of the male of any other race.

Harrisson and Buchan (1936) found that each parent tended to take 2 "rests" per hour, staying away from the nest for from 10 to 20 minutes, and Yeates (1948) recorded interludes of about 20 minutes at a Shetland Wren's nest though I never did. Intermissions of as long as 20 minutes at a European Wren's nest are rare, but I have known a Hebridean Wren's young to remain unvisited for 31 minutes. Theoretically such pauses could be due either to the young being satiated and not stimulating the parents by begging or to the scarcity of food necessitating interludes while the parents satisfied their own hunger. As the feeding tempo is more rapid at nests of European Wrens the latter hypothesis is more probable.

Food Brought to the Nestlings

Noctuid and geometrid larvae are brought to the young, as are crane flies (tipulids) and other diptera, earwigs, spiders, and centipedes (Harrisson and Buchan, 1934). This diet is similar to that of Shetland and Hebridean wrens, except that they have not been known to receive earwigs and are given moths. Atkinson (1949) saw fat, white maggots brought to a brood, and a St. Kilda Wren was seen to give a fragment of an earthworm to the nestlings (Lowe, 1934). A pair which Lowe watched foraging on the beach was noticed chasing sandhoppers (*Talitrus*), but other observers noted that during the breeding season the wrens do not forage to any considerable extent on the shore. Shetland Wrens nesting by the sea-shore do not give molluscans or crustaceans to their nestlings (Armstrong and Thorpe, 1952). Lowe's belief (1934: 101) that St. Kilda Wrens extract molluscs from their shells "in the same way that snails are extracted by thrushes" (*Turdus ericetorum*) is pure speculation.

Adults feed on a variety of arthropods, such as those already mentioned and including beetles (Clarke, 1915). Dixon (1888) saw a bird pursue a flying insect, and Clarke (1915) found remains of seeds and vegetable tissue in the stomachs of birds killed in September and October. Inside many of the cleits where wrens feed lies the more or less desiccated and disintegrated carcass of a Soay sheep, for these animals go to cover to die. In a sheltered spot a sick animal is less

liable to be attacked by rapacious birds. As I saw a wren feeding close around one of these carcasses, it is possible that wrens eat some of the organisms which batten on dead sheep. The maggots which Atkinson saw given to nestlings may have been the larvae of diptera from a carcass.

NEST SANITATION

The feces are removed by both sexes. Harrisson and Buchan (1936) noted the interval between taking sacs as averaging 45 minutes, but they did not mention the age or number of the young. When the young are about a week old the parents no longer enter the nest but receive the extruded sac as they cling to the threshold; Atkinson noted, however, that when one of the young had already left the nest a parent went inside twice to clean it. Harrisson and Buchan watched birds wiping off sacs on old wire clothes lines. Shetland Wrens will make use of a wire fence for the same purpose, and I have seen European and Hebridean wrens wipe off the feces on branches. Feces are usually carried well away from the nest as is customary with other races and many other passerines.

FLEDGING

As with other races, one or more young St. Kilda Wrens are apt to fly out of the nest prematurely if disturbed. Atkinson noticed that after a youngster had flown, one of the parents, apparently the male, fed it while his mate tended the remaining youngsters without assistance. Both parents accompany and feed the fledged young. Atkinson saw juveniles, so fully developed as to be indistinguishable from adults, following and importuning their parents for food. Kearton found fledged young very agile in escaping capture by dodging in and out of crevices. Juvenile Shetland Wrens are equally wary.

DISPERSAL

In September and October, Clarke (1915) found wrens here and there all over Hirta, including the moorland, beach, and glen. Before Harrisson and Buchan left on August 14 they noted the beginnings of this dispersal, and one of the birds observed away from the breeding areas was probably a juvenile. Mr. L. S. V. Venables tells me that the "spread-out" of Shetland Wrens occurs at the beginning of August. Iceland Wrens disperse after breeding, mainly to the coast (Armstrong, 1950a), and juvenile European Wrens also wander widely but apparently begin to do so in July or even to a minor extent at the end of June. There is no evidence that St. Kilda Wrens leave the group of islands.

MORTALITY

In two of four nests from which the young had fledged Ferguson-Lees found a dead chick aged three to four days. He also discovered a whole brood dead in the nest. No ticks were found on any young, although in a recently vacated nest there were numerous flea larvae, probably *Dasypsyllus gallinulae*, which has been recorded from a wren on St. Kilda (M. Rothschild, 1952). The cause of this mortality is uncertain, but it is most plausibly attributed to an inadequate food supply. Elliott (1895) and Atkinson (*in litt.*) reported infertile eggs in nests. In this connection it may be noted that in 1951 the writer examined three recently vacated nests of European Wrens in succession, finding a dead chick in each of two of them and an infertile egg in the third. The spring of 1951 was wet, the breeding season late, and the incidence of infertile eggs and nest mortality in some species high (Campbell, 1951). Human mortality in Britain was also high and butterflies were scarce. So far as nest mortality among birds is concerned, the lack of adequate food appears to have been a major factor. The most plausible hypothesis to explain the high mortality in 1948 among the village wrens of St. Kilda is that the population was too dense for the food supply available. It will be remembered that this was the only year on record when the village slopes as well as the village held a considerable number of wrens. Ferguson-Lees' observations of extensive territorial trespass by birds foraging for nestlings are consistent with this hypothesis. If it be valid, the situation on St. Kilda provides evidence in support of the thesis which I have advocated elsewhere (1952, and *in press*), that food-supply is fundamental in determining the nature of the pair-bond in *T. troglodytes* and probably other species.

In one nest Harrisson and Buchan found four chicks, but no broods of more than three fledged young were seen. They estimated that approximately one young left the nest for every two eggs laid. If this is correct, mortality for which predators are not responsible is at this stage considerably higher than among European Wrens. However, Ferguson-Lees reckoned the average number of fledged young in the families he saw to be four.

PREDATION

Lowe regards cats as having contributed largely to the alleged decline in the number of wrens. He refers to them as having been recently introduced but does not further substantiate this rather surprising statement. It is difficult to believe that primitive folk on

an island supporting two species of mice did not keep cats. About a dozen cats were left behind in 1930, but by 1931 there were only three survivors. Two females, one with kittens, were shot, leaving only the male (Harrisson and Moy-Thomas, 1933). No cat has been seen since. Although cats destroy wrens and their nests, and no doubt ate St. Kilda Wrens, there is no evidence that either cats or mice seriously affected the numbers of wrens. There were not many more than 12 individuals of the apparently now extinct house mouse (*Mus musculus muralis*) in 1931 (Harrisson and Moy-Thomas, 1933). This mouse was restricted to the houses and dependent on man. As the St. Kilda yellow-necked mouse (*Apodemus flavicollis hirtensis*) is apparently almost entirely vegetarian (Waterston, 1905) it cannot be a serious menace to the wren. Attempts to trap it with cheese were a failure. No mice are found on Boreray, so that on this island the wrens are certainly free from all mammalian predation. Although Harrisson and Buchan's statement that natural enemies of the wren are absent from St. Kilda seems somewhat rash, it is unlikely that mammalian or avian predation has a significant effect on the wren population.

Harrisson and Buchan justifiably dismiss Seebohm's notion that the peculiarities of the St. Kilda Wren's coloration enable it to escape the attacks of "hungry hawks." The St. Kilda Peregrines (*Falco peregrinus*) have worthier quarry to pursue than wrens. Population control must be mainly effected by environmental factors other than predation and probably the most important is the availability of food.

DISCUSSION

Although our knowledge of the St. Kilda Wren is based on scattered observations and several observers have drawn incorrect inferences from the data, it is evident that the behavior of this race diverges in some respects from that of *T. t. troglodytes*. The latter's adaptations include polygamy, multiple nest-building, regular second broods, and highly functional song; but the St. Kilda Wren is monogamous, builds few nests, is probably often single-brooded, and song seems to play a somewhat lesser rôle in its life. In these respects the behavior of the St. Kilda Wren approximates that of other northern insular races. Although little has been recorded of the Asian and North American subspecies, it seems that the races of *T. troglodytes* tend towards one of two types, "northern insular" or "continental," the former being characterized by monogamy, the latter by polygamy and a high development of multiple nest-building.

Probably these distinctions in pair-bond and behavior are determined by the availability of food for the nestlings, since the wrens of the bleakest habitats are the least polygamous. The St. Kilda Wren belongs to this type, and we have noted various indications that, at least in some seasons, it suffers from food stringency, territorial trespassing, slow feeding tempo at the nest, and nest mortality. Taken separately each of these might be explained as due to some other factor, but together the hypothesis of lack of available food is most plausible. On the other hand, the polygamy of the European Wren is correlated with a relatively highly available food supply. To what extent these differences in behavior are environmentally determined or have become innate and genetically fixed is debatable. In regard to song there are strong grounds for believing that the racial differences have a genetic basis, and it may well be found that in some other respects divergence in behavior is more than a merely environmental adaptation. One is impressed by the fact that wren accommodation to a new type of environment is attained by the integration of a group of adaptations. Such integrative adaptation may play an important part in speciation.

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SUMMARY

1. The literature dealing with the St. Kilda Wren is critically examined, and it is argued that, contrary to the opinion of a number of writers, the bird was never near extermination. It is also suggested that legislation designed to preserve it was not only ineffective but may have increased its jeopardy.

2. Evidence is adduced indicating that numbers fluctuate considerably.

3. The sexual food territory concept is shown to be unproven.

4. Information in regard to the breeding cycle is reviewed and comparisons made with other races.

5. The St. Kilda Wren's behavior and breeding biology are shown to be more closely akin to those of other northern insular races than to those of *T. t. troglodytes*.

6. It is suggested that in *T. troglodytes* two types of integrated adaptations are apparent: the "continental," characterized by a polygamous pair-bond; and the "northern insular," characterized by monogamy.

7. The thesis is advanced that the availability of food in the breeding season determines to which of these types wrens belong.

8. Attention is called to the significance of integrated groups of ethological adaptations in speciation.

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CALCULATION OF EGG VOLUME BASED ON LOSS OF WEIGHT DURING INCUBATION

BY EDVARD K. BARTH

The volume of an egg (inclusive of shell) is an important parameter exact determination of which is of great value in certain ornithological problems. Since eggs show different shapes, the volume is not a one-valued function of the lengths of the axes; likewise the weight is variable and has meaning only in newly-laid eggs.

The volume can be determined exactly by any method using the principle of displacement of water, or flotation. Many of these methods require special apparatus, particularly if the egg has been incubated for some time and does not sink. Blowing-out an egg and subsequently filling the shell with a liquid of known specific gravity is also a cumbersome procedure.

In the present paper a method will be offered that demands a minimum of mechanical equipment, viz: a small ordinary balance and a container of any kind to make a water test. The method is therefore particularly suited for determinations in the field. Observations were made chiefly at Heröy, Norway, on eggs of the Common Gull (*Larus canus*), which nests along the entire coast of southern Norway.

The derived formula is independent of the axial lengths and shape of the egg and is based on the observed loss of weight during the time of incubation. The formula can therefore be used for computing volumes from literature data of the weight of newly-laid eggs.

Review of Literature

An egg that has been incubated for a few days weighs less than the newly-laid egg. Heinroth (1922) showed a method of determining the original weight. He took the egg and, after having blown out its contents, filled it with water. According to Heinroth, the weight of the egg filled with water is practically the same as that of the egg before incubation. Groebbels and Möbert (1927b) held that, by adding about 2.5 — 3.0 per cent of the weight, the most correct results are to be found.

Groebbels (1927) presented observations on the decrease of the specific gravity of the egg during the course of incubation and gave a brief summary of the previous works on this subject. I therefore do not include these earlier papers in the present bibliography.

Groebbels weighed the eggs, found their volumes by observing the quantity of water displaced in a specially constructed vessel, and examined their contents. But only in a few instances did he follow

the time/weight curve of the individual egg. All eggs without exception were, for at least some time, put into an incubator, or in some other way taken out of their natural environment. In another paper Groebbels and Möbert (1927a) presented data on the loss of weight in eggs of 17 different species of birds, and found that the results differed in the different species. Horton (1932) gave the loss of weight of domestic duck eggs. Pringle and Barott (1937) have shown that small eggs generally have comparatively greater losses of weight than do large ones. Small eggs have greater surface in proportion to their mass; consequently they have potentialities for a comparatively greater evaporation and loss of weight.

Groebbels (1937) quoted various older papers dealing with shape, surface, and volume of eggs. Formulas have been proposed showing the relations of these data, but all include the lengths of the axes, thus introducing a degree of uncertainty and invalidating the results.

Szielasko (1920) introduced the so-called "symmetry factor" as a measure of the shape, and Grossfeld (1933) tried to use Szielasko's data in computing egg volumes, but found it impracticable because of the complexity of the equations. Grossfeld therefore applied the formula for an ellipsoid of rotation—0.524 $L\ B^2$ modified to 0.519 $L\ B^2$—to obtain the volume. Romanoff and Romanoff (1949) reported that a number of different constants have been used in this equation. They thought that an error of less than two per cent could be obtained for hens' eggs of various sizes and shapes by using 0.526.

Schönwetter (1925) used the formula of the ellipsoid to compute the weights of newly-laid eggs. Bergtold (1929) used a similar method and proposed the equation, $w = 11/21\ L\ B^2\ S$, where S is the specific gravity. The fraction, $11/21 = 0.5238$, is identical with the constant in the formula for the ellipsoid. Bergtold also experimented with filling empty egg-shells with various liquids and recommended chloroform as the most suitable. Westerskov (1950) used Bergtold's simplified formula, $V = 0.51\ L\ B^2$. Worth (1940) has proposed the formula $V = 0.85\left(\frac{\pi\ L\ B^2}{6}\right)$.

NEW OBSERVATIONS ON *Larus canus*

A water-test is made by putting the egg into water. (Water from nearby ponds and streams was used. This water carries a surprisingly small amount of soluble matter, and approaches the qualities of distilled water; the specific gravity can be taken as equal to 1.) If the egg is newly-laid, it will sink; after having been incubated a few days,

its rounded end will rise a little from the bottom. A little more than a week's incubation will make it stand straight up in the water, the pointed end barely touching the bottom. After about nine days' incubation, the egg shows a tendency to rise from the bottom, and after 10 to 11 days, it will settle directly under the surface. The loss of weight continues; after about two weeks' incubation, the rounded end of the egg protrudes above the water. As time goes on, its long axis becomes more and more oblique in the water, because the air-filled compartment, which lies in the rounded end of the egg, grows steadily larger, and moves obliquely down towards the pointed end of the egg. At the stage when it barely floats (or more correctly, when it remains suspended in the water), the specific gravity of the whole egg is one.

As distinct from other workers, I have systematically studied the eggs in their natural environment, except for the short time taken to make flotation tests, and I have followed each egg during the whole incubation period. A total of 65 eggs from 31 different clutches was observed. Their average weight was 52.0 gm., newly-laid. When the young bird first cracked open its shell, the eggs averaged 42.5 gm., and at the concluding stage of hatching the average weight was 41.0 gm. The chick usually starts working at the egg shell, trying to pierce it, 3.5 days before it is fully-hatched. Before this period, the rate of the loss of weight per unit of time is constant as showed by repeated weighings. After the egg is cracked, the rate steadily increases. When the chick starts breathing with its lungs, the rate of the excretion of water increases. The more intensely the chick works to get out of the shell, the greater is the loss of weight. More and more cracks become visible on the egg shell, and about 24 hours before hatching there are definite holes in the shell. At this point the rate of the loss of weight increases still more; during the last 24 hours the average egg reduces its weight by as much as 1.5 gm.

Forty-one eggs were used for a methodical study of the water-test. For these eggs I have accurate observations for the time of the development of the embryo, and for the time of the eggs floating up. Table 1 gives the arithmetical mean weights for these 41 eggs, together with the median deviation and the extremes of the observations. The median deviations, m, are worked out by the equation $m = \pm\sqrt{\frac{(b-A)^2}{n}}$ where b is each separate observation, n the number of observations (= number of eggs), and A the arithmetical mean for the n observations.

The eggs float up after being incubated on the average for 42.4 per cent of total time of development, and the total loss of weight in

per cent of weight of newly-laid eggs averages 21.8. Two of the carefully studied eggs (not recorded in the tables) had decided cracks in their shells, and as a consequence showed an exceptionally great loss of weight. Nevertheless, the embryos developed and hatched.

TABLE 1

AVERAGE DATA ON 41 EGGS OF *Larus canus*

(The average time of development is 25 days)

Weight in grams	*Arithmetic Mean and Median Deviation*	*Greatest Variation from arithmetic Mean*	*Observed Range*
Weight of newly-laid egg, (w_0)	53.3 ± 4.3	8.3	45.0–61.5
Number of days before floating up	10.6 ± 1.5	2.6	8 –13
Time before floating up in percentage of total time of development	42.4		32.0–52.0
Weight when just floating up (v)	49.3 ± 3.9	7.3	42.0 –56.5
Loss of weight before floating up	4.0 ± 0.5	1.0	3.0–5.0
Loss of weight per day before floating up (k)	0.38 ± 0.07	0.18	0.25–0.56
Total loss of weight in per-cent of weight of newly-laid egg	21.8		17.3–35.0
Specific gravity of newly-laid egg ($d_0 = w_0/v$)	1.081 ± 0.0075	0.017	1.068–1.098

All these eggs floated 8 to 13 days after they had been laid. If we put each day in a category by itself, the results are as given in table 2.

Small eggs lost weight more rapidly than large ones. This is shown in table 2 by combining the first three categories (8 to 10 days before floating, average weight 52.3 gm.) and the last three (11 to 13 days before floating, average weight 54.4 gm.). It is not possible, however, to use this as a definite rule. Small eggs may float late, and large eggs may float early.

At that point in the incubation period when the egg's specific gravity (shell + contents) is one, *then the figure for the total weight in grams is the same as that for the volume in cubic centimeters.* This gives a possibility for an exact determination of the volume of eggs. The method is based on the buoyancy, and is therefore *independent of the shape of the egg.* All equations for calculating the volume based on the axes of the eggs will give great errors. To look at an egg as an ellipsoid of rotation will in a few instances be correct. In the Laridae

the shape of the egg varies greatly even within the same species. Two eggs may have the same length and breadth and still have different volumes. The extremes are represented by those shaped like pears. By weighing such eggs, it is immediately possible to distinguish the great difference in their mass, even though their axes are the same. For this reason it is important that the equation for the volume does not contain the figures for the axes.

TABLE 2

CORRELATION BETWEEN TIME OF FLOATING AND WEIGHT OF EGGS

Number eggs	*Number days before floating up*	*Average weight, newly-laid egg*	*Number eggs*	*Average weight, newly-laid egg*
4	8	50.6 gm.		
4	9	53.8	21	52.3 gm.
13	10	52.5		
7	11	54.5		
8	12	54.3	20	54.4 gm.
5	13	54.4		
Total 41			41	

GENERAL FORMULAE

The following relation defines the volume: $V = w/d$, where w is the weight and d is the specific gravity. If the egg is newly-laid we put: $V = w_0/d_0$.

From table 1 we find $d_0 = 1.081$; hence

$V = 0.925\ w_0$ for *L. canus*.

During the incubation period the weight decreases regularly by an amount, k grams per day, until the chick starts pecking at the shell. After n days we have: $w_n = Vd_0 - kn$, or $V = w_n + kn/d_0$; w_n (or w_0) is found by weighing each time; d_0 and k must be determined empirically for each species. Table 1 shows that, in *L. canus*, $k = 0.38$, and $d_0 = 1.081$; consequently, $V = 0.925\ (w_n + 0.38n)$ for *L. canus*.

If n is unknown, a water test can approximate it. The median error and maximum error of the volume thus computed are $\pm$ 0.3 cc. and $\pm$ 0.7 cc., respectively. (These figures correspond to the median deviation and maximum deviation in d_0 as listed in table 1.)

According to my observations, the eggs of few kinds of birds vary as greatly in size, shape, and quality of the shell, as those of the gull. The range of the variation of d_0 and k should be smaller therefore for birds other than the Laridae.

For other kinds of birds average values for d_0 and k are now being computed. As examples, some preliminary figures are given in table 3. (For comparison, the data of *L. canus* are repeated.)

If weight and specific gravity of the shell are known, the internal volume of an egg can be computed. My data demonstrate that the weight of the empty shell of eggs of *L. canus* is close to 3.0 gm., and Schönwetter has determined that the specific gravity approximates 2.0. Thus the average internal egg volume is $V' = 0.925\ w_0 - 3/2 =$ 47.8 cc. for *L. canus*.

TABLE 3

AVERAGE DATA ON EGGS OF VARIOUS BIRDS

Species	*Weight of newly-laid egg* (w_0) *in grams*	*Loss of weight pr. day* (k) *in grams*	*Volume* (V) *in cubic centimeters*	*Specific gravity of newly-laid egg* (d_0)	*Formula for volume of newly-laid egg, and for egg after* n *days of incubation*
Larus argentatus	97.0	0.50	90.99	1.066	$V = 0.938\ w_0$ $V = 0.938\ (w_n + 0.50\ n)$
Larus fuscus	76.7	0.37	71.48	1.073	$V = 0.932\ w_0$ $V = 0.932\ (w_n + 0.37\ n)$
Larus canus	53.3	0.38	49.3	1.081	$V = 0.925\ w_0$ $V = 0.925\ (w_n + 0.38\ n)$
Haematopus ostralegus	43.5	0.32	39.02	1.087	$V = 0.920\ w_0$ $V = 0.920\ (w_n + 0.32\ n)$
Sterna hirundo	21.0	0.167	19.49	1.078	$V = 0.928\ w_0$ $V = 0.928\ (w_n + 0.167\ n)$
Tringa totanus	21.0	0.118	19.70	1.066	$V = 0.938\ w_0$ $V = 0.938\ (w_n + 0.118\ n)$
Turdus pilaris	8.0	0.10	7.40	1.081	$V = 0.925\ w_0$ $V = 0.925\ (w_n + 0.10\ n)$
Delichon urbica	1.91	0.02	1.81	1.056	$V = 0.947\ w_0$ $V = 0.947\ (w_n + 0.02\ n)$
Phylloscopus trochilus	0.95	0.0125	0.90	1.056	$V = 0.947\ w_0$ $V = 0.947\ (w_n + 0.0125\ n)$

COMPARISON OF METHODS

I have mentioned that Groebbels and Möbert computed the egg volume by adding not more than 3 per cent to the weight of the egg filled with water. Let us use this method on my material listed in table 1. The average egg of *L. canus*, filled with water, will weigh 47.8 + 1.4 = 49.2 gm. The correct value is, however, 53.3 gm.; the Groebbels-Möbert method thus gives values that are about 8 per cent too low.

The equation for the volume of a hen's egg, given by Grossfeld, is: $V = 0.519\ L\ B^2$, where, as stated previously, L is the egg's long axis, and B its short axis. Through measuring 382 eggs from *L. canus*, I

have found the following averages: $L = 5.74$ cm., $B = 4.10$ cm., and weight when newly-laid (w_0) = 51.8 gm. Grossfeld's equation gives here: $V = 0.519 \cdot 5.74 \cdot 4.10^2 = 50.1$ cc. My equation, $V = 0.925\ w_0$, gives: $V = 0.925 \cdot 51.8 = 47.9$ cc. Thus the values of Grossfeld's are about 4.5 per cent too large. Grossfeld thinks that his formula can be used to determine the volume of eggs in collections (blown-out eggs). This may, however, lead to serious errors.

An almost identical formula, $V = 0.51\ L\ B^2$, was given by Bergtold (1929) and used by Westerskov (1950) on pheasants' eggs. Worth uses, $V = 0.85 \left(\frac{\pi\ L\ B^2}{6}\right)$, which may be reduced to $0.445\ L\ B^2$.

Measurements carried out on the 41 eggs listed in table 1 give, as average values, $L = 5.819$ cm. and $B = 4.126$ cm. Used on this material, Grossfeld's formula and Bergtold's and Westerskov's formula give volumes that are respectively 2.1 cc. and 1.2 cc. too large, whereas Worth's formula results in a volume that is 5.2 cc. too small.

Johannes Erstad (1945) has examined hens' eggs, and weighed 83 of them. Further, he has calculated the volume of the eggs by immersion in water. He also has determined the specific gravity and measured the long and short axes for all the eggs. In tabular form he has made a comparison between his own calculations of the volume, and the volumes he arrived at by using Grossfeld's equation (see above). When using this equation, the results usually give large errors, especially for the distinctly pear-shaped and spherical eggs.

From the specific gravity of all eggs tabulated by Erstad, I have arrived at the following relation for the volume: $V = 0.930\ w_0$ for hens' eggs.

Table 4 shows the volume relation of eggs that, according to Erstad, are of abnormal shape. The calculated volumes, according to the methods of Grossfeld, Bergtold and Westerskov, and of myself, are compared with the correct volumes as directly measured by Erstad.

Eggs No. 3, 11, and 22 must have been shaped like pears because the earlier authors' formulae give figures which are too large. Nos. 49 and 72 must have been almost spherical, giving figures which are too small. By the use of Worth's formula still greater discrepancies will result. These calculations demonstrate the fundamental inadequacy of any volume formula based on measurement of the axial length of an egg.

The use of Heinroth's method for determining the weight of newly-laid eggs, in connection with Erstad's tables, gives good results by adding about 2 per cent to the weight of the water-filled egg shells, as Groebbels and Möbert have pointed out.

For *L. canus* I have shown that one must add about 8 per cent to the weight of the water-filled shell to get the correct result. The reason for this difference is chiefly due to weight of the shell which is much greater for eggs of domestic chickens than for those of *L. canus*.

TABLE 4

VOLUME RELATIONS OF HENS' EGGS ACCORDING TO VARIOUS AUTHORS
(All data in cubic centimeters)

Table of Erstad, egg no.	*Correct volume, according to Erstad*	*Volume calculated after Grossfeld*	*Variation from correct volume*	*Volume calculated after Bergtold and Westerskov*	*Variation from correct volume*	*Volume calculated after Barth*	*Variation from correct volume*
3	59.99	64.8	+ 4.8	63.73	+ 3.74	59.38	− 0.61
11	57.43	62.0	+ 5.0	60.97	+ 3.54	57.33	− 0.10
22	62.69	65.2	+ 2.5	64.05	+ 1.36	62.99	+ 0.30
49	48.21	46.1	− 2.1	45.29	− 2.92	48.41	+ 0.20
72	68.58	65.6	− 3.0	64.47	− 4.11	68.89	+ 0.31

CONCLUSIONS

The known formulae for computing the volume of eggs are unsatisfactory because they are based on measurements of the length of the axes of the eggs.

A new formula which is independent of the shape of the egg and which is usable for eggs of all species is offered for consideration. It is based on the general relation—$V = w/d$—where V is the volume, w the weight, and d the specific gravity of an egg.

The specific gravity of a newly-laid egg has a characteristic value for each kind of bird; for *Larus canus*, $d_0 = 1.081$ and consequently $V = 0.925\ w_0$ for *L. canus*, where w_0 is the weight of the newly-laid egg. After n days of incubation the weight, w_n, shows the following relation: $w_n = Vd_0 - kn$, where k is a constant denoting the loss of weight suffered by the egg per day. Consequently, $V = (w_n\ kn)/d_0$, or $V = 0.925\ (w_n + 0.38n)$ for *L. canus*.

For *L. canus*, values of d_0 and k have been found statistically, and preliminary values have been calculated for some other kinds of birds (see table 4). The value of w_0 (or w_n) must be determined by weighing each time.

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THE SHAPES OF BIRDS' EGGS

BY F. W. PRESTON

The usual way of describing a bird's egg is to report its length and maximum diameter. The latter is not the diameter at the mid-point of the length, as a rule, because most eggs are bigger at one end than the other. A statement of length and maximum diameter is not a complete description therefore, and the question arises whether a complete description *can* be given, and, if so, how many measurements are needed to define it. Obviously, it requires at least three, but it may take more. In fact, it will be shown in what follows that most avian eggs require four measurements or "constants" (that is, two in addition to length and breadth), and that some require five. The problem then becomes one of finding a general equation suitable for *all* eggs, of expressing the facts in the simplest, most logical, and most convenient way, and of devising apparatus for measuring the eggs and deducing the constants.

This investigation was not undertaken primarily as a mathematical amusement. It seems likely that it may throw some light on several biological and ecological problems, but the present paper concerns itself merely with the broad question of what *is* the shape of a bird's egg. The mathematics may conceivably show something of the physiology and mechanics of egg-laying, since the shape of the egg is a response to the forces exerted by the oviduct during shell-formation (Mallock, 1925; D'Arcy Thompson, 1943). These biological problems are perhaps more interesting than the purely geometrical one of defining egg shape. Thompson (*op. cit:* 936, footnote) seems to throw up his hands in the belief that egg shape is indescribable, particularly if it happens to be a guillemot's (= murre's). Romanoff and Romanoff (1949: 88) are more explicit: "The numerous variations in the contour of individual eggs obviously cannot be expressed in mathematical terms." It seems to me that, on the contrary, nothing can be more obvious than that, as a matter of theory, any such shape should be readily described; and, as a matter of fact, they take very little describing, and the results appear interesting. The present paper will, therefore, be confined to a logical development of the mathematical aspects, leaving the biological and other problems, for which they may provide a solution, for later papers.

Since this paper was completed and accepted by the A.O.U., I have received through the kindness of Professor Bartels and Dr. Storer, both of Ann Arbor, Michigan, a reprint of a paper by Jun-ichi Okabe ("On the Forms of Hens' Eggs" Reports of Research Institute

for Applied Mechanics, Kyushu University, Vol. 1, No. 1, 1952) in which the shape of eggs is treated as a problem in the forces that mold that shape, as D'Arcy Thompson would have wished, and the shape is then used to deduce the forces involved. This is a problem in mechanics, and even in its approximate form, leads to some striking conclusions, biological and otherwise. It differs entirely in treatment, and in purpose, from this present paper, which is purely geometrical and descriptive in nature, and aims to discover with accuracy what *is*

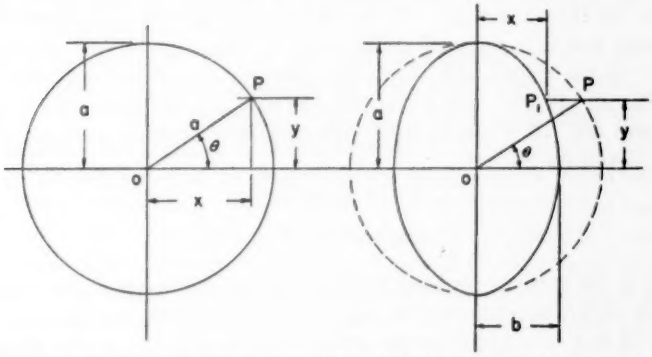

FIGURE 1 (*left*). Parametric equation of a circle in terms of the eccentric angle.
FIGURE 2 (*right*). Parametric equation of an ellipse.

the shape of an egg before, or without, attempting an analysis of the forces necessary to produce that shape. It seems logical to assume that it may be possible to establish a connection between the "constant" or parameters of Jun-ichi Okabe and the present writer, but this is not yet certain.

A still more recently received paper (Bradfield, J. R. G., Radiographic studies on the formation of the hen's egg shell, Journ. Exper. Biol., 28: 125–150, 1951) greatly clarifies the mechanism of shell formation, and makes it unnecessary to pursue further this aspect of the problem.

A circle may be defined by the parametric equation (cf. fig. 1)

$$y = a \sin \theta$$
$$x = a \cos \theta. \qquad (1)$$

Here a is the "radius vector" drawn from the center O to a point P on the perimeter, and θ is the angle this radius makes with the x axis.

A circle may be otherwise defined. For instance, in polar coordinates, by the simple equation

$$r = a \text{ (where } a \text{ is a constant),}$$

or in Cartesian coordinates by

$$x^2 + y^2 = a^2 .$$

For our purpose, however, the parametric equation is the most useful, because we can gradually elaborate on it till it describes all conceivable forms of eggs.

The first step in the elaboration is to develop the parametric equation for an ellipse (fig. 2). If the circle be imagined as pivoted along its y axis, and then rotated around this so that it makes an angle with respect to the paper, the circle will appear "foreshortened" and will look like an ellipse. All x-coordinates will be shortened in the same ratio, say b/a, all y coordinates will remain unaltered, and our parametric equation becomes

$$\begin{aligned} y &= a \sin \theta \\ x &= b \cos \theta . \end{aligned} \tag{2}$$

Here a is the semi-major axis, b the semi-minor axis, and θ has become what is called the "eccentric angle." It is not the angle which the radius vector to a point on the *ellipse* makes with the x axis, but the angle to the corresponding point on the original, circumscribing, circle.

The ellipse may be described in various other ways; for instance, in Cartesian coordinates, it is given by

$$\frac{x^2}{b^2} + \frac{y^2}{a^2} = 1 .$$

However, we need the parametric form.

Now, the first and most obvious thing about a typical egg is that it is always *somewhat* elongated: an ellipsoid is a closer approximation than a sphere, and for some eggs an ellipse may be a sufficient approximation. The ordinary method of describing eggs, with two constants only, amounts mathematically to saying that this is good enough. However, the great majority of eggs are clearly larger at one end than at the other, and all of them prove to be so when measured. In all that follows we shall imagine that the egg has its long axis vertical and the big end uppermost.

The simplest parametric equation we can use to describe an egg in this position is then

$$\begin{aligned} y &= a \sin \theta \\ x &= b \cos \theta \, (1 + c_1 \sin \theta) \end{aligned} \tag{3}$$

where c_1 is a "dimensionless" constant that may vary from egg to egg, but is constant for any particular specimen. This equation represents what I shall call the "simple" or "perfect" ovoid. By introducing this one new constant, c_1, we can describe all eggs to a very fair approximation, but not always to the limits of experimental accuracy. To show the degree of approximation graphically, figure 3 has been prepared. It shows the effect of changing the ratio of b/a and of varying c_1. It will be immediately obvious that a whole family of egg forms can thus be developed and that they do not depart a great deal from the known forms of eggs.

That equation (3) is the simplest and most logical form of an ovoid may be seen as follows: our objective is to make the top half of the egg wider than the bottom half, while taking care to keep the left-hand side symmetrical with the right-hand. It is a case of dilating the top and constricting the bottom while requiring the curve to pass through the points marking the ends of the major and minor axes of the ellipse. These conditions can be met only by postulating a correction term, for the x coordinate, which is a function of $\sin\theta$ and of nothing else. The advantage of the parametric form of the equation is that it permits us to write this fact down in mathematical form by mere inspection.

Careful comparison of actual eggs with this equation shows, however, that though it represents some eggs very well, it is not quite right for the majority. We may, therefore, develop the mathematics generally. *Any* egg, as we have seen, must conform to the equation

$$y = a \sin\theta$$
$$x = b \cos\theta \cdot \varphi(\sin\theta) \qquad (4)$$

where $\varphi(\sin\theta)$ is some function of $\sin\theta$ yet to be discovered experimentally.

We may reasonably assume that $\varphi(\sin\theta)$ can be expanded in series, so that

$$\varphi(\sin\theta) = c_0 + c_1 \sin\theta + c_2 \sin^2\theta + c_3 \sin^3\theta + - - \qquad (5)$$

and obviously, from what we have seen already, $c_0 = 1$, and in most eggs the other coefficients are much less than unity, and most often are a rapidly declining series. c_1 will always be positive, because we have said the big end of the egg is to be uppermost, but c_2 and c_3 may be negative. In nearly all the cases so far examined c_2 is negative. This has the effect of making both ends of the egg slightly more *conical* than in the Simple Ovoid. We may therefore call this the Biconical Term and refer to eggs having only c_1 and c_2 terms as the Standard Avian Egg-Shape, for c_3 is usually zero or negligible.

In a few cases c_3 is not negligible. Since it is attached to a term of sin θ which is an odd power (the cube of sin θ), the effect of a non-negligible c_3 is to emphasize the attenuation of one end of the egg and the blunting of the other, whereas the coefficients of even terms (c_2 for instance) attenuate, or blunt, both ends equally. To date I have found sizeable values of c_3 only in the murres and their allies, and a few others, so an ovoid in which c_3 is important may be called an Alcid Ovoid.

Except in a very few eggs, I have not found c_2 negligible. It has apparently a maximum value in the plover and gull groups, so that it characterizes the charadriid and larid ovals; it is also important in the ostrich group.

In no case to date have I found it necessary to consider terms higher than $\sin^3 \theta$.

Therefore, the general equation of birds' eggs is finally

$$\begin{aligned} y &= a \sin \theta \\ x &= b \cos \theta \, (1 + c_1 \sin \theta + c_2 \sin^2 \theta + c_3 \sin^3 \theta) \end{aligned} \tag{6}$$

which, except in the case of the Alcids, reduces to

$$\begin{aligned} y &= a \sin \theta \\ x &= b \cos \theta \, (1 + c_1 \sin \theta + c_2 \sin^2 \theta). \end{aligned} \tag{6a}$$

For a few eggs

$$\begin{aligned} y &= a \sin \theta \\ x &= b \cos \theta \, (1 + c_1 \sin \theta), \end{aligned} \tag{6b}$$

and for a few others, whose two ends are virtually alike, we may have

$$\begin{aligned} y &= a \sin \theta \\ x &= b \cos \theta \, (1 + c_2 \sin^2 \theta). \end{aligned} \tag{6c}$$

In a later section (table 5) we compare the observed and calculated values for a number of representative eggs of a wide variety of species belonging to different orders. It is necessary first to consider how the observed values may best be ascertained and the constants computed.

Methods of Observation.—When, in the early stages of this investigation, it seemed probable that equation (6b), that for the Simple Ovoid, adequately represented actual eggs, it was logical to believe that a measurement of the curvature of each end, together with a measurement of the length and the maximum diameter, would give all the information required. As a matter of fact, it would theoretically give more than this, for it would give four measurements to determine three constants, and so one measurement would be redundant, or

could be used as a check on the others. This was tried first on eggs of the domestic fowl (*Gallus gallus*), both pullets and adults. Very often the results were remarkably close. The length of the egg and the curvatures at the two ends were used to predict the maximum diameter, and frequently did so to less than 1 per cent. This is an exceedingly severe test, using minute areas near each end to predict the shape of the whole egg. For this purpose a special spherometer was devised.

This method has much to recommend it, but only if the egg is a Simple Ovoid. But most eggs are Standard Avian (Biconical) or Alcid.

A better method would seem to be to measure the diameters of the egg at various places along the length. If we divide the length l ($2a$ in fig. 2) of the egg into eight equal parts, the "latitudes" of these subdivisions, when referred to the circumscribing circle, are the values of the parameter θ such that:

$$\sin\theta = 0, \pm \tfrac{1}{4}, \pm \tfrac{1}{2}, \pm \tfrac{3}{4}, \pm 1.$$

The positive values in this set correspond to the "north latitude" or big end of the egg, and the negative values to the "south latitude;" the value 0 corresponds to the "equator," and the values $\pm$ 1 to the "poles." These values for the sin θ are simply the values of y/a at the points of subdivision. At each of these points we may measure the "diameter" of the cross-section of the egg. These measurements represent the values of $2x$ for the corresponding latitudes θ (or sin θ).

The value of $2x$ at the poles is zero, so that no information pertaining to the coefficients c_1, c_2, and c_3 in the formulae (6) can be derived from these points. The value of $2x$ at the equator is $2b$. Note that in general the maximum diameter is greater than $2b$ and occurs north of the equator. In the computation of the value of $2x$ at the other latitudes in the set chosen above we make use of the values in the following table:

$\sin\theta$	$\sin^2\theta$	$\sin^3\theta$	$\cos\theta$
$\pm$ 1/4	1/16	$\pm$ 1/64	0.968
$\pm$ 1/2	1/4	$\pm$ 1/8	0.866
$\pm$ 3/4	9/16	$\pm$ 27/64	0.661

With this information and the measured values of the diameters, $2x$, we can determine optimum values for the constants c_1, c_2, and c_3.

The real problem is, how should we measure the diameters at the various latitudes selected? It is particularly desirable to get accurate estimates of diameters at sin $\theta = \pm \tfrac{3}{4}$, *i. e.*, fairly close to the poles,

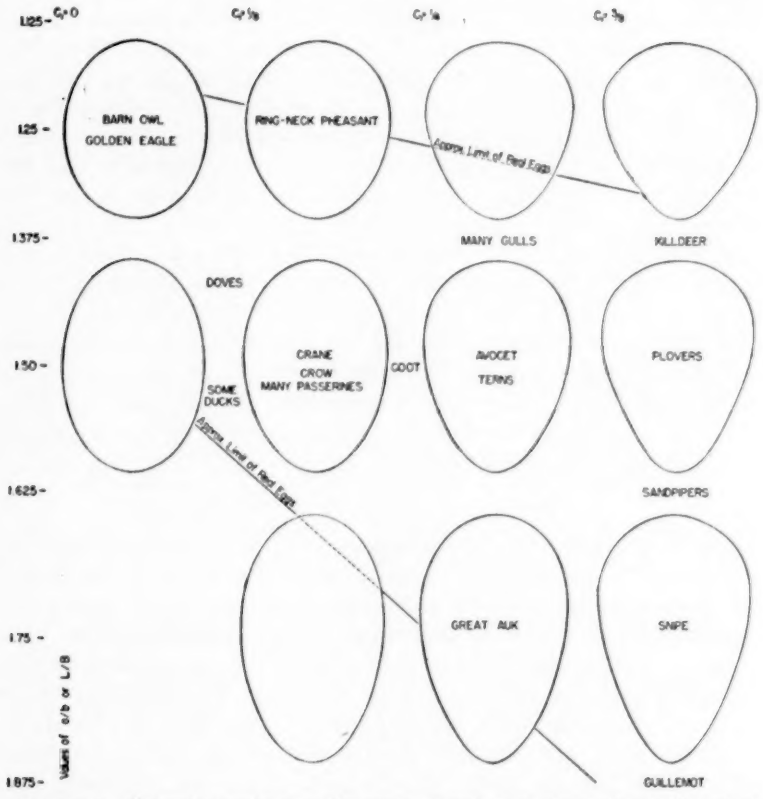

FIGURE 3. "Simple" ovals over the range of values of elongation (a/b) and of ovalness (c_1) found among real eggs. [Note: the c_2 and c_3 terms are assumed to be zero in making this drawing.]

but here the egg is tapering off so rapidly that measuring the solid egg needs special techniques. We have so far found it preferable to use a profile diagram of the egg, representing a longitudinal, or "meridian," section.

This can be done approximately by photography. Mallock (1925) used a pinhole camera. Dresser (1910) has a whole volume of very fine photographic plates. It is in fact from this work that the positions of characteristic eggs are plotted on our figure 3. However, this did not prove entirely satisfactory, for several reasons. The margin of an egg in a photograph is always slightly fuzzy and exact diameters are hard to measure. More important, perhaps, is the fact that an egg does not lie with a meridian plane horizontal. The pointed end

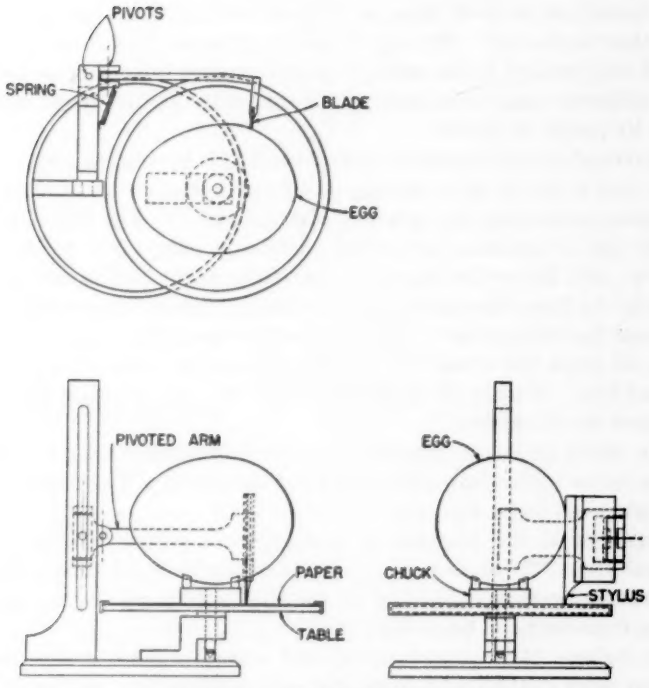

FIGURE 4. Profile-copying machine.

is always lower. By propping up the small end of the egg a satisfactory photograph might be obtained, but the process is in any case cumbersome, and the film and photographic paper may shrink or expand with processing. Further, with large eggs, the aperture of the lens may not permit it to "see" the meridian plane, which lies "below the horizon."

We therefore used a profile-copying machine of our own devising which was much quicker, more accurately represented the desired section, and permitted easier measurements (see fig. 4).

Description of profile-transfer (fig. 4).—The apparatus consists of a circular table, mounted on tight-fitting ball-bearings and free to rotate on a vertical axis. On this table is placed a sheet of typewriter carbon paper, face up, and on top of this a sheet of thin white paper, face down. The papers are held down at the rim by a simple retaining ring that slips over them and fits the edge of the table. A "chuck" to hold the egg is mounted concentrically with the table and above it; it has three, or four, prongs or fingers faced with pressure-sensitive

tape, sensitized on both sides, so that one side sticks to the prongs and the other to the egg. The egg is laid on them so that its axis is horizontal and parallel to the table, is gently pressed into place so that the tape adheres, and, if necessary, is kept under gentle finger pressure while its profile is traced.

A pivoted arm is mounted on a vertical axis beyond the edge of the table, and is drawn up to the egg by a light spring, so that the egg acts as a cam controlling the arm as "cam-follower." The follower bears on the egg by means of a vertical blade-edge carrying a stylus at the bottom, and the stylus bears on the white paper by its own weight. In order to keep this constant, a horizontal pivot is provided in the arm near the vertical one. The pressure of the stylus causes the carbon paper to mark the under side of the white paper with a very sharply defined line. We usually go twice around the egg, to make sure there has been no movement.

The white paper is inserted and removed readily by providing it in the center with a hole that slips over the chuck. The carbon paper does not need to be removed.

Examples of the tracings or profilings are shown in figure 5, 5/9 natural size. These show the varieties of shapes and indicate that extreme forms were included and are readily "graduated" with equations of the type we have been discussing.

We believe that observational and computational errors, in our present work dealing with large eggs and with profiles measured without the benefit of travelling microscopes or other special devices, are normally about 0.1 to 0.2 mm., at times a little more. Consequently, we consider the observed shape to be accurately represented within the limits of experimental error when the computed values do not differ from the observed ones by a residuum which greatly exceeds this figure. A tenth of a millimeter is four-thousandths of an inch, and about twice the diameter of a human hair. The extent of agreement will be obvious from the tabular matter.

Fitting Measurements by "Least Squares."—If we know that an egg is a true ellipsoid, it is sufficient to measure its length and its diameter at any known "latitude," preferably at the "equator." Any further measurements are redundant, and cannot be used unless there are experimental errors in the measurements, or unless the actual shape is not a true ellipsoid and we agree to compromise on an "ellipsoid of best fit" for descriptive purposes. In such a case the accepted method is the method of least squares, that is, the minimizing of the sum of the squares of all the "errors," which are defined as the differences between observed and calculated values.

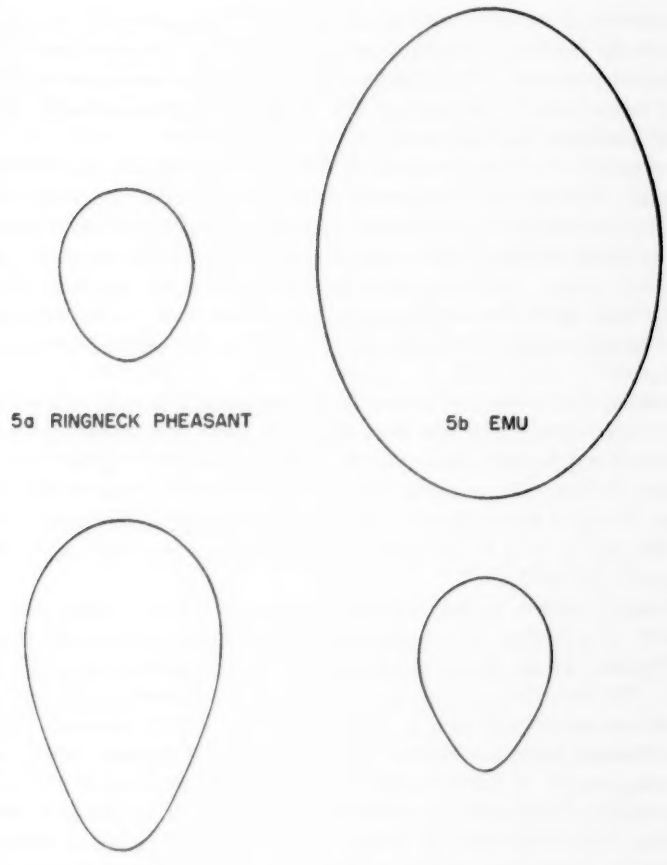

FIGURE 5. Representative Egg Shapes.. All eggs in Preston Collection.

5a. *Ring-necked Pheasant* (England). An approximation to a "simple" oval. The c_1 term is moderately large, the c_2 term rather small, and c_3 negligible. Some eggs of the Domestic Fowl, the Common Loon, and the Golden Eagle are equally good representatives of the simple oval. 5b. *Emu*. An approximation to the biconical form. The egg is *not*, as might be thought at first sight, a good ellipse. This egg is, in effect, the reverse of 5a, in that the c_2 term is substantial and the c_1 term very small. The Tinamou's egg is even more extreme than this. 5c. *Common Murre* (Wales). In this egg c_1 is very high, c_3 very high (but negative, of course), and c_2 (the biconical element) very small. This is the typical Alcid egg, just as the Tinamou's is the typical biconical. 5d. *Lapwing* (England). Here both c_1 and c_3 are large, while c_2 is negligible. This is the characteristic plover egg.

Similarly, if we assume that the egg is a "simple oval," adequately defined by its length, equatorial diameter, and the constant c_1 that defines the amount of ovateness, then we cannot measure more than three experimental values, say the length and two diameters at different latitudes, without redundancy.

A normal avian egg, however, is found by experience to contain the c_2 term. In fact, in struthious birds, including the tinamous, the c_2 term is more important that the c_1 term. The egg is more biconical (in the sense of the present author, not necessarily in Dresser's sense) than it is ovate. Thus, to describe the egg we need, theoretically, the length and three diameters, neither more nor less. This will permit us to assign values to both c_1 and c_2, even though one of them may be zero.

Finally, in the case of the Alcids (guillemots, murres, Great Auk, and a few others like the Red-throated Loon and some gulls) it is necessary or at least advisable, if great accuracy is required, to take measurements at four diameters, but in no case is it necessary to use more, though I have used an equation for Dresser's *photograph* (1910: pl. 102, fig. 1) of a Great Auk's egg, involving the equivalent of *five* measured diameters.

However, when a contour has been obtained, it is easy and convenient to measure the diameter at seven places (nine including the two "poles" where the diameter is zero) equally spaced along the polar axis. We then have a considerable excess of measurements, and their proper use involves fitting by least squares. This is standard practice in statistical work, but it is not often that an egg-shaped curve, or one as complicated, is fitted in this manner, and some interesting points come out. Other methods of fitting are permissible, but this method has the advantage that it eliminates all personal equation and automatically produces a result in which we can have considerable confidence. It has two disadvantages. First, the computations are, superficially, a little formidable, and second, the assumption is made that errors of measurement are likely to be equally as great at one diameter as at another.

The great advantage is that the proceedings can be reduced to a very simple routine, and turned over to the operator of a calculating machine. The process of boiling it down to this routine is what looks formidable, but actually it is merely tedious once, and forever after there is nothing to it.

A considerable simplification is effected if the diameters that are measured are symmetrically distributed above and below the equator or mid-point in the length. Then for every sin θ there is a sin $(-\theta)$,

which is numerically equal to it but opposite in sign and cancels it out in such summations as involve odd powers of sin θ like $\Sigma \sin \theta$, $\Sigma \cos \theta \sin \theta$, $\Sigma \cos \theta \sin^3 \theta$, etc. (but not in terms involving measured diameters k, like $\Sigma k \sin \theta$, $\Sigma k \cos \theta \sin^3 \theta$; see below).

A second great simplification is introduced by agreeing that we will always divide the length into eight equal parts, never more and never less, so that we have a numerical value of purely trigonometric functions $\Sigma \cos \theta$, $\Sigma \sin \theta \cos \theta$, etc., which is the same throughout our work on all eggs. It is this which boils the whole procedure down to a simple routine.

It is necessary to decide first what equation we are going to fit to our observational data. We may try a simple ellipsoid, a simple oval, a biconical oval, or an alcid equation. A good deal of experience suggests that for any egg but the extreme form, the most convenient choice is the biconical, but for a few it is better to use the alcid.

Let us suppose for a moment, however, that we had decided to use the simplest of all, the ellipse.

Its equation, for the abscissa, is $x = b \cos \theta$. (8)

This is more conveniently written $2x = B \cos \theta$, where $B = 2b$. (8a)

Now what we measure at latitude θ is a diameter, which we may call k, to distinguish it from the theoretical diameter $2x$.

The "error" or "residuum" is $(2x - k) = (B \cos \theta - k)$, and its square is $(B \cos \theta - k)^2$.

The "least squares" method involves summing the squares of the residuals at the several values of θ, for which we have experimental values k, and making the sum a minimum.

That is, $\Sigma (B \cos \theta - k)^2$ or $\Sigma (B^2 \cos^2 \theta - 2Bk \cos \theta + k^2)$ is to be a minimum.

Σk^2 cannot be changed, and so this becomes

$$B^2 \Sigma (\cos^2 \theta) - 2B \Sigma (k \cos \theta) \text{ is to be a minimum.}$$

Differentiating with respect to B and setting the result equal to zero gives

$$2B \Sigma (\cos^2 \theta) - 2 \Sigma (k \cos \theta) = 0$$

or

$$B = \frac{\Sigma (k \cos \theta)}{\Sigma (\cos^2 \theta)}. \tag{9}$$

This gives us the optimum value of B, which is the only "unknown" for a simple ellipse.

When we come to egg shapes proper, we get more complicated equations, and have to differentiate with respect not only to B, but

to c_1, c_2, and c_3, or as many of them as we assume to be present in our equations. The procedure is just the same as before, but the equations get increasingly complex. Since we differentiate with respect to all of our adjustable factors we necessarily end up with as many simultaneous equations as there are adjustables. We can, therefore, solve for all of our unknowns.

TABLE 1

SUMMARY OF EQUATIONS FOR BEST FITTING CURVES

Best Fitting *Ellipse*. One unknown, viz. B $(= 2b)$

$$B = Z_{0\,1}/T_{0\,2}$$

Best Fitting *Simple oval*. Two unknowns, viz. B and c_1

$$B\,[T_{0\,2} + c_1^2 \cdot T_{2\,2}] = [Z_{0\,1} + c_1 \cdot Z_{1\,1}]$$

$$c_1 = \frac{1}{B} \cdot \frac{Z_{1\,1}}{T_{2\,2}}$$

Best Fitting *Standard Avian Oval*. Three unknowns, viz. B, c_1, and c_2

$$B\,[T_{0\,2} + (c_1^2 + 2c_2)\,T_{2\,2} + c_2^2\,T_{4\,2}] = [Z_{0\,1} + c_1 \cdot Z_{1\,1} + c_2 \cdot Z_{2\,1}]$$

$$c_1 = \frac{1}{B} \cdot \frac{Z_{1\,1}}{T_{2\,2}} \quad \text{(same as for Simple Oval)}$$

$$c_2 = \frac{1}{B}\left[\frac{Z_{2\,1}}{T_{4\,2}}\right] - \frac{T_{2\,2}}{T_{4\,2}}$$

Best Fitting *Alcid Oval*. Four unknowns, viz. B, c_1, c_2, and c_3

$$B\,[T_{0\,2} + (c_1^2 + 2c_2)\,T_{2\,2} + (2c_1 c_3 + c_2^2)\,T_{4\,2} + c_2^2\,T_{6\,2}] = [Z_{0\,1} + c_1 Z_{1\,1} + c_2 Z_{2\,1} + c_3 Z_{3\,1}]$$

$$c_1 = \frac{1}{B}\left[\frac{Z_{1\,1}\,T_{0\,2} - Z_{3\,1}\,T_{4\,2}}{T_{2\,2}\,T_{6\,2} - (T_{4\,2}^2)}\right]$$

$$c_2 = \frac{1}{B}\left[\frac{Z_{2\,1}}{T_{4\,2}}\right] - \frac{T_{2\,2}}{T_{4\,2}} \quad \text{(same as for Standard Avian Oval)}$$

$$c_3 = \frac{1}{B}\left[\frac{Z_{3\,1} \cdot T_{2\,2} - Z_{1\,1} \cdot T_{4\,2}}{T_{2\,2} \cdot T_{6\,2} - (T_{4\,2})^2}\right]$$

The resulting equations are none the less somewhat elaborate-looking. In order to condense them it will be convenient to develop a sort of mnemonic or shorthand.

Let us write $\Sigma\ (\sin^m \theta \cos^n \theta)$ as $T_{m\,n}$, and

$$\Sigma\ (k \sin^m \theta \cos^n \theta) \text{ as } Z_{m\,n}.$$

Here T means that the function is purely trigonometric, while Z means that the measured value k, at each latitude θ, is involved.

If $m = 0$, $\sin^m \theta = 1$, so that $T_{0\,n}$ is $\Sigma\ (\cos^n \theta)$, and our equation (9) above becomes

$$B = Z_{0\,1}/T_{0\,2}$$

In all that follows it is assumed, as previously mentioned, that for every diameter we measure north of the equator there is another measured at the same distance south of the equator. This causes a few terms to cancel out which would be present if we did not have a symmetrical arrangement of measuring points. Subject to this symmetry, the tabulation above (table 1) does *not* require that the latitudes be equally spaced, or that there be eight, or any other particular number of levels for measuring.

These equations are somewhat general, as above mentioned, and now a further simplification can be introduced if we agree that we will always divide the polar axis into eight equal parts, and measure the diameters at the places where $\sin \theta = \frac{3}{4}, \frac{1}{2}, \frac{1}{4}, 0, -\frac{1}{4}, -\frac{1}{2}$, and $-\frac{3}{4}$. Under these circumstances, all the T functions become simple numerical values. These values are given in table 2 below.

TABLE 2

NUMERICAL VALUES OF THE "T" FUNCTIONS

$T_{0\,2}$	$= \Sigma \cos^2 \theta = 5.25$
$T_{2\,2}$	$= \Sigma \sin^2 \theta \cos^2 \theta = 0.984375$
$T_{4\,2}$	$= \Sigma \sin^4 \theta \cos^2 \theta = 0.377930$
$T_{6\,2}$	$= \Sigma \sin^6 \theta \cos^2 \theta = 0.179626$
$(T_{4\,2})^2$	$= 0.142831$

Substituting these numerical values in the formulae of table 1 greatly simplifies those formulae so far as c_1, c_2, and c_3 are concerned. The equation for B, however, remains a cubic, and therefore complicated. A further simplification is therefore greatly to be desired. We find this in the fact that, while we have no idea in advance what the values of c_1, c_2, and c_3 are going to be, we *do* know that B is going to come out very close to the observed value k_0 ($= 2x_0$), the measured equatorial diameter.

In practice we have found it satisfactory to assume that B can be replaced by the observed value k_0, which should be measured with care, and, fortunately is usually the easiest of all the diameters to measure with precision.

A better approximation than that obtained by simply setting B equal to k_0 could be obtained by setting $B = k_0 + \Delta k_0$, where the unknown "correction" Δk_0 to the simpler estimate for the value of B is assumed to be so small that its square and cube can be neglected.

When this is valid we can replace B^2 and B^3 by their approximates $k_0^2 + 2k_0 \cdot \Delta k_0$ and $k_0^3 + 3k_0^2 \cdot \Delta k_0$, respectively. We thus obtain a linear equation in the correction Δk_0. But the task of formulating this equation, though linear and readily soluble, is tedious. We have not found that it is worth the trouble.

We therefore proceed to assume that $B = k_0$ and that the equations for the "c" values are those of table 3, where numerical values from table 2 are substituted in the formulae of table 1. We confine table 3 to Standard Avian and Alcid types.

TABLE 3

FORMULAE FOR COMPUTING THE "c" VALUES OF EGG SHAPES

Standard Avian Oval

$$c_1 = \frac{1}{k_0}(1.0159\, Z_{1\,1})$$

$$c_2 = \frac{1}{k_0}(2.6460\, Z_{2\,1}) - 2.6046$$

$$(B = k_0)$$

Alcid Oval

$$c_1 = \frac{1}{k_0}(5.2850\, Z_{1\,1} - 11.1195\, Z_{2\,1})$$

$$c_2 = \frac{1}{k_0}(2.6460\, Z_{2\,1}) - 2.6046 \quad \text{(Same as for Standard Avian)}$$

$$c_3 = \frac{1}{k_0}(28.9624\, Z_{2\,1} - 11.1195\, Z_{1\,1})$$

$$(B = k_0)$$

It is now possible to eliminate the last traces of trigonometric functions, because we use only a limited number of positions of θ, for which $\sin\theta$, $\cos\theta$, and more complicated ones like $\sin^2\theta \cdot \cos\theta$ have stock values. This permits us to write down the Z-values as simple linear functions of the observed diameters. This is done in table 4 below.

The process of computing now becomes very simple, and is as follows:

On a profile of the egg, divide the polar axis into eight equal parts, corresponding to "latitudes" given by $y/a = \sin\theta = \frac{3}{4}, \frac{1}{2}, \frac{1}{4}, 0$ (the "equator"), $-\frac{1}{4}$, $-\frac{1}{2}$, and $-\frac{3}{4}$. Measure the diameter at each latitude, and call these *measured* diameters, $k_{3/4}$, $k_{1/2}$, . . . $k_{-3/4}$.

From table 4 compute $Z_{1\,1}$ and $Z_{2\,1}$, and if the egg is believed Alcid in type, compute also $Z_{3\,1}$.

From table 3, using these values of Z, compute the "c" values.

We now have the "best fitting" mathematical equation of our egg, and it describes the whole contour of the egg, *i. e.*, its shape.

If now we want to see how good a fit we have, we use the equation to compute the diameters at the standard latitudes, and compare these computed diameters with the observed ones.

TABLE 4

THE *Z*-VALUES

$[Z_{0\,1} = 0.6614\ (k_{3/4} + k_{-3/4}) + 0.8660\ (k_{1/2} + k_{-1/2}) + 0.9682\ (k_{1/4} + k_{-1/4}) + k_0]$

Not used in Standard Avian or Alcid types.

$Z_{1\,1} = 0.4961\ (k_{3/4} - k_{-3/4}) + 0.4330\ (k_{1/2} - k_{-1/2}) + 0.2421\ (k_{1/4} - k_{-1/4})$

$Z_{2\,1} = 0.3720\ (k_{3/4} + k_{-3/4}) + 0.2165\ (k_{1/2} + k_{-1/2}) + 0.0605\ (k_{1/4} + k_{-1/4})$

$[Z_{3\,1} = 0.2790\ (k_{3/4} - k_{-3/4}) + 0.1083\ (k_{1/2} - k_{-1/2}) + 0.0151\ (k_{1/4} - k_{-1/4})]$

Used only in Alcid types.

Since the murres are commonly regarded as having the most extreme forms of eggs, I have tabulated the computed and observed values of these eggs first, in table 5, section A. Then follow a variety of examples, most of which are adequately "graduated" by a Standard Avian type of equation. Finally, in section C, I have included Dresser's figure of the egg of the Great Auk, carried out to the term involving $\sin^4 \theta$.

In table 4, for ease of reference, are given the "*c*" values of these eggs.

It should not be assumed that in a given species these "*c*" values are constants. They are not even constants for a given individual bird, the eggs of a clutch differing markedly one from another, which is a useful and perhaps important biological phenomenon, and will be the subject of a second communication.

Discussion.—Perhaps the most interesting thing is that the shape of even extreme eggs can be so well represented with so few terms and constants. The next is the almost universal presence of the c_2 or biconical term. This is related to the physiology of the oviduct, and in some species changes during the progress of the clutch, and so may have useful ecological implications. The ingenuity of the murre in fitting its egg so well to an equation which may well seem quite formidable to a mere seafowl is to be commended. The skill of the lapwing in eliminating the c_3 term while retaining a high value of the c_2 term is also noteworthy.

Another interesting point is the importance in struthious birds of the c_2 term compared with the c_1 term. The two ends of the egg are very much alike, but the egg is not elliptical. It is biconical, the c_2 term being relatively large.

However, for ordinary descriptive purposes it is likely that orni-

thologists or oologists will not wish to compute terms beyond the first. The unassisted eye will not normally be able, unless well educated, to detect the existence of further terms, but the existence of c_1 will nearly always be very obvious. If profiles are all reduced, or enlarged to a standard size, they can be compared with the chart of figure 3 and reasonably close values of b/a and of c_1 can be assigned without measurement. This will permit a description of the shape with very fair accuracy, and will give a much better picture than the present conventional methods.

A couple of points of mathematical interest may be noted. The c_2 term is independent of the c_1 and c_3 terms, but the c_1 and c_3 terms are not independent of one another. The differential equations, in the form in which they are first obtained (though not shown in this present text), express these coefficients explicitly one in terms of the other. The present text reports them in a later stage when this complication has been eliminated, for purposes of computation. However, the interdependence persists, and if we assume that the egg is Standard Avian, *i. e.*, that $c_3 = 0$, we shall get a different value of c_1 from that which will obtain on the assumption that the egg is Alcid, *i. e.*, that c_3 is not zero. As previously indicated, c_2 will not be affected in the slightest by our choice of assumptions in this particular, but it would be affected by the assumption that a c_4 term is present. The reason is that the odd terms, c_1 and c_3, both tend to make the egg large at one end and small at the other, while the even terms affect both ends equally, as mentioned at the outset. It might be expected that an egg of "extreme" type, such as a murre's, would have a positive value of c_3 and that c_3 would partially replace the more moderate term c_1. In practice that is not what happens. The c_3 term is always negative, apparently, thus permitting c_1 to assume a very high value. A positive value of c_3 would tend to flatten the big end of the egg, and this end always shows a somewhat hemispherical character.

Table 6 indicates the effect on c_1 of assuming the zero or non-zero value of c_3 for several species of birds.

In practically all eggs so far examined c_2 is negative unless it is very nearly zero.

Finally, it should not be thought that the equations we have been using are restricted to representing conventional "egg" shapes. They will equally well represent pears, peg-tops, figures of eight, dumb-bells, and numerous others still more complicated. Egg shapes are merely those in which all coefficients are rather small, and are generally confined to the first two or three. It is, therefore, not remarkable that egg shapes are rather readily represented by our equations.

TABLE 5

SECTION A

Family Alcidae *Uria aalge* Common Murre (Preston Collection)

$L = 2a = 85.2 \quad y = a \sin\theta \quad 2x = 47.5 \cos\theta \quad (1 + 0.374 \sin\theta - .041 \sin^2\theta - .127 \sin^3\theta)$

k	¾	½	¼	0	−¼	−½	−¾
$2x$ (calc.)	37.8	47.8	50.1	47.5	41.7	33.7	23.6
$2x$ (obs.)	37.8	47.8	50.0		41.7	33.6	23.6
calc. − obs.	0	0	+0.1	0	0	+0.1	0

Family Alcidae *Uria lomvia* Brünnich's Murre (Carnegie Museum)

$L = 2a = 75.1 \quad y = a \sin\theta \quad 2x = 47.1 \cos\theta \quad (1 + .3816 \sin\theta - .0842 \sin^2\theta - .1111 \sin^3\theta)$

$2x$ (calc.)	37.1	47.1	49.6	47.1	41.1	32.7	22.2
$2x$ (obs.)	37.1	47.2	49.6		41.0	32.8	22.2
calc. − obs.	0	−0.1	0	0	+0.1	−0.1	0

Family Gaviidae *Gavia stellata* Red-throated Loon (Carnegie Museum)

$L = 2a = 79.9 \quad y = a \sin\theta \quad 2x = 43.1 \cos\theta \quad (1 + .1963 \sin\theta + .0693 \sin^2\theta - .1151 \sin^3\theta)$

$2x$ (calc.)	32.4	41.1	43.9	43.1	39.9	34.8	26.8
$2x$ (obs.)	32.5	41.0	43.8		39.9	34.7	26.9
calc. − obs.	−0.1	+0.1	+0.1	0	0	+0.1	−0.1

TABLE 5

SECTION B

Family Dromiceiidae *Dromiceius novaehollandiae* Emu (Preston Collection)

$L = 2a = 127.4 \quad y = a \sin\theta \quad 2x = 89.2 \cos\theta \quad (1 + .014 \sin\theta - .078 \sin^2\theta)$

k	¾	½	¼	0	−¼	−½	−¾
$2x$ (calc.)	57.0	76.3	86.2	89.2	85.6	75.2	55.8
$2x$ (obs.)	56.7	76.6	86.6		85.7	75.3	55.8
calc. − obs.	−0.3	−0.3	−0.4	0	−0.1	−0.1	0

Family Rheidae *Rhea americana* Rhea (Carnegie Museum)

$L = 2a = 123.3 \quad y = a \sin\theta \quad 2x = 90.3 \cos\theta \quad (1 + .0312 \sin\theta - .0884 \sin^2\theta)$

$2x$ (calc.)	58.2	77.7	87.6	90.3	86.3	75.3	55.4
$2x$ (obs.)	57.9	78.0	88.0		86.4	75.7	55.1
calc. − obs.	+0.3	−0.3	−0.4	0	−0.1	−0.4	+0.3

Family Tinamidae *Rhynchotus rufescens* Tinamou (Carnegie Museum)

$L = 2a = 56.4 \quad y = a \sin\theta \quad 2x = 45.7 \cos\theta \quad (1 + .0061 \sin\theta - 0.1399 \sin^2\theta)$

$2x$ (calc.)	28.0	38.3	43.9	45.7	43.8	38.1	27.7
$2x$ (obs.)	28.0	38.3	43.9		43.9	37.9	27.8
calc. − obs.	0	0	0	0	−0.1	+0.2	−0.1

TABLE 5

SECTION B (*Continued*)

Family Spheniscidae *Spheniscus demersus* Cape Penguin (Carnegie Museum)

$L = 2a = 84.3$ $y = a \sin\theta$ $2x = 54.4 \cos\theta$ $(1 + .064 \sin\theta - .0027 \sin^2\theta)$

k	¾	½	¼	0	−¼	−½	−¾
$2x$ (calc.)	37.7	48.6	53.5	54.4	51.8	45.6	34.2
$2x$ (obs.)	37.8	48.4	53.5		51.9	45.5	34.2
calc. − obs.	−0.1	+0.2	0	0	−0.1	+0.1	0

Family Cariamidae *Cariama cristata* Seriama (Carnegie Museum)

$L = 2a = 62.2$ $y = a \sin\theta$ $2x = 46.7 \cos\theta$ $(1 + .1056 \sin\theta - .0523 \sin^2\theta)$

$2x$ (calc.)	32.4	42.0	46.3	46.7	43.9	37.8	27.5
$2x$ (obs.)	32.4	42.0	46.1		43.5	37.4	27.9
calc. − obs.	0	0	+0.2	0	+0.4	+0.4	+0.4

Family Gaviidae *Gavia immer* Common Loon (Carnegie Msueum)

$L = 2a = 94.3$ $y = a \sin\theta$ $2x = 54.9 \cos\theta$ $(1 + .1257 \sin\theta - .0149 \sin^2\theta)$

$2x$ (calc.)	39.4	50.4	54.8	54.9	51.4	44.4	32.6
$2x$ (obs.)	39.1	50.6	55.0		51.1	44.2	32.9
calc. − obs.	+0.3	−0.2	−0.2	0	+0.3	+0.2	−0.3

Family Pelecanidae *Pelecanus erythrorhynchos* White Pelican (Carnegie Museum)

$L = 2a = 86.3$ $y = a \sin\theta$ $2x = 56.0 \cos\theta$ $(1 + .0690 \sin\theta - .0747 \sin^2\theta)$

$2x$ (calc.)	37.4	49.3	54.9	56.0	53.0	45.9	33.6
$2x$ (obs.)	37.2	49.5	55.1		52.9	46.3	33.4
calc. − obs.	+0.2	−0.2	−0.2	0	+0.1	−0.4	+0.2

Family Anatidae *Branta canadensis* Canada Goose (Preston Collection)

$L = 2a = 85.2$ $y = a \sin\theta$ $2x = 60.0 \cos\theta$ $(1 + .127 \sin\theta - .070 \sin^2\theta)$

$2x$ (calc.)	41.9	54.3	59.7	60.0	56.0	47.7	34.3
$2x$ (obs.)	42.0	54.3	59.5		56.0	47.6	34.4
calc. − obs.	−0.1	0	+0.2	0	0	+0.1	−0.1

Family Accipitridae *Aquila chrysaëtos canadensis* Golden Eagle (Carnegie Museum)

$L = 2a = 74.4$ $y = a \sin\theta$ $2x = 57.6 \cos\theta$ $(1 + .1115 \sin\theta - .0163 \sin^2\theta)$

$2x$ (calc.)	40.9	52.5	57.3	57.6	54.2	46.9	34.6
$2x$ (obs.)	41.0	52.2	57.3		53.7	46.6	34.9
calc. − obs.	−0.1	+0.3	0	0	+0.5	+0.3	−0.3

Family Pandionidae *Pandion haliaëtus carolinensis* Osprey (Carnegie Museum)

$L = 2a = 62.1$ $y = a \sin\theta$ $2x = 43.6 \cos\theta$ $(1 + .1070 \sin\theta - .0207 \sin^2\theta)$

$2x$ (calc.)	30.8	39.6	43.3	43.6	41.0	35.5	26.2
$2x$ (obs.)	30.6	39.8	43.3		40.8	35.4	26.4
calc. − obs.	+0.2	−0.2	0	0	+0.2	+0.1	−0.2

TABLE 5

SECTION B (*Continued*)

Family Phasianidae *Phasianus colchicus* Ring-necked Pheasant (Preston collection)

$L = 2a = 44.0$ $y = a \sin\theta$ $2x = 33.3 \cos\theta$ $(1 + .1050 \sin\theta - .041 \sin^2\theta)$

k	¾	½	¼	0	−¼	−½	−¾
$2x$ (calc.)	23.2	30.0	33.0	33.3	31.3	27.1	19.8
$2x$ (obs.)	23.2	30.0	33.0		31.1	27.2	19.8
calc. − obs.	0	0	0	0	+0.2	−0.1	0

Family Phasianidae *Gallus gallus* Domestic Fowl (Preston Collection)

$L = 2a = 51.8$ $y = a \sin\theta$ $2x = 40.5 \cos\theta$ $(1 + .0797 \sin\theta - .0349 \sin^2\theta)$

$2x$ (calc.)	27.9	36.2	39.9	40.5	38.3	33.4	24.7
$2x$ (obs.)	27.9	36.2	39.8		38.3	33.6	24.5
calc. − obs.	0	0	+0.1	0	0	−0.2	+0.2

Family Gruidae *Grus canadensis* Sandhill Crane (Carnegie Museum)

$L = 2a = 93.6$ $y = a \sin\theta$ $2x = 62.0 \cos\theta$ $(1 + .1135 \sin\theta - .0296 \sin^2\theta)$

$2x$ (calc.)	43.8	56.3	61.6	62.0	58.2	50.2	36.8
$2x$ (obs.)	43.8	56.3	61.7		58.3	50.0	37.0
calc. − obs.	0	0	−0.1	0	−0.1	+0.2	−0.2

Family Haematopodidae *Haematopus palliatus* Oyster-catcher (Carnegie Museum)

$L = 2a = 58.2$ $y = a \sin\theta$ $2x = 38.5 \cos\theta$ $(1 + .1253 \sin\theta - .1750 \sin^2\theta)$

$2x$ (calc.)	25.2	34.2	38.1	38.5	35.8	29.9	20.5
$2x$ (obs.)	25.4	34.0	38.0		35.7	29.8	20.6
calc. − obs.	−0.2	+0.2	+0.1	0	+0.1	+0.1	−0.1

Family Charadriidae *Vanellus vanellus* Lapwing (Preston Collection)

$L = 2a = 40.7$ $y = a \sin\theta$ $2x = 33.3 \cos\theta$ $(1 + .252 \sin\theta - .161 \sin^2\theta)$

$2x$ (calc.)	24.2	31.3	33.9	33.3	29.9	24.0	15.9
$2x$ (obs.)	24.2	31.3	33.9		30.0	23.8	16.0
calc. − obs.	0	0	0	0	−0.1	+0.2	−0.1

Family Laridae *Larus fuscus* Lesser Black-backed Gull (Preston Collection)

$L = 2a = 65.0$ $y = a \sin\theta$ $2x = 45.7 \cos\theta$ $(1 + .163 \sin\theta - .068 \sin^2\theta)$

$2x$ (calc.)	32.8	42.1	45.9	45.7	42.3	35.7	25.4
$2x$ (obs.)	32.6	42.3	45.8		42.1	35.3	25.7
calc. − obs.	+0.2	−0.2	+0.1	0	+0.2	+0.4	−0.3

Family Laridae *Larus argentatus* Herring Gull (Preston Collection)

$L = 2a = 72.0$ $y = a \sin\theta$ $2x = 45.0 \cos\theta$ $(1 + .244 \sin\theta - .024 \sin^2\theta)$

$2x$ (calc.)	34.8	43.5	46.2	45.0	40.8	34.0	23.9
$2x$ (obs.)	34.6	43.6	46.2		40.4	33.7	24.3
calc. − obs.	+0.2	−0.1	0	0	+0.4	+0.3	−0.4

TABLE 5

SECTION B (*Continued*)

Family Laridae *Larus canus* European Common Gull (Preston Collection)

$L = 2a = 58.6$ $y = a \sin\theta$ $2x = 42.0 \cos\theta$ $(1 + .185 \sin\theta - .119 \sin^2\theta)$

k	¾	½	¼	0	−¼	−½	−¾
$2x$ (calc.)	29.8	38.7	42.2	42.0	38.5	31.9	22.1
$2x$ (obs.)	29.5	39.0	42.5		38.8	32.0	22.0
calc. − obs.	+0.3	−0.3	−0.3	0	−0.3	−0.1	+0.1

Family Laridae *Rissa tridactyla* Kittiwake (Carnegie Museum)

$L = 2a = 56.1$ $y = a \sin\theta$ $2x = 42.2 \cos\theta$ $(1 + .1634 \sin\theta - .0881 \sin^2\theta)$

$2x$ (calc.)	30.0	38.7	42.3	42.2	39.0	32.8	23.1
$2x$ (obs.)	29.9	38.9	42.5		38.9	32.8	23.3
calc. − obs.	+0.1	−0.2	−0.3	0	+0.1	0	−0.2

Family Corvidae *Corvus corone* European Carrion Crow (Preston Collection)

$L = 2a = 41.7$ $y = a \sin\theta$ $2x = 28.9 \cos\theta$ $(1 + .177 \sin\theta - .085 \sin^2\theta)$

$2x$ (calc.)	20.7	26.7	29.1	28.9	26.6	22.3	15.7
$2x$ (obs.)	20.5	27.0	29.2		26.5	22.5	15.6
calc. − obs.	+0.2	−0.3	−0.1	0	+0.1	−0.2	+0.1

TABLE 5

SECTION C

Family Alcidae *Pinguinus impennis* Great Auk (Dresser, 1910, pl. 102, fig.1)

$L = 2a = 115$ mm. $y = a \sin\theta$ $2x = 66.1 \cos\theta$ $(1 + 0.320 \sin\theta - 0.074 \sin^2\theta - 0.152 \sin^3\theta + 0.159 \sin^4\theta)$

k	¾	½	¼	0	−¼	−½	−¾
$2x$ (calc.)	51.78	64.82	68.72	66.1	58.77	48.68	34.42
$2x$ (obs.)	51.8	64.8	68.6	66.2	58.8	48.6	34.4
calc. − obs.	0.0	0.0	+0.1	−0.1	0.0	+0.1	0.0

It will be obvious that in many cases the residual divergences between calculated and observed values are extremely small, well inside the experimental errors. In a few cases they fall just outside the strictly observational errors, and the reasons will usually be obvious on inspection. For instance, in the case of the Emu, since all residues are negative, we could get more perfect agreement by retaining the "c" values but increasing the k_0 value (observed equatorial diameter) by 0.2 mm., which would give a more probable value of B (calculated equatorial diameter) and would increase all the other calculated diameters.

In the case of the Seriama, a *reduction* of k_0 by 0.2 mm. would produce closer agreement, and there is some evidence that a tiny $\sin^2$ term may be present, since the errors are not symmetrical about the equator.

TABLE 6

VALUES OF *C*

Bird	*Standard Avian*		*Alcid*		
	c_1	c_2	c_1	c_2	c_3
A					
Red-throated Loon	0.1520	0.0691	0.1966	0.0691	−0.1162
Common Murre	0.325	−0.0415	0.3747	−0.0415	−0.1291
Brünnich's Murre	0.3388	−0.0844	0.3824	−0.0844	−0.1136
B					
Emu	0.014	−0.0784	0.0222	−0.0784	−0.0213
Rhea	0.0312	−0.0886			
Tinamou	0.0061	−0.1400			
Cape Penguin	0.0640	−0.0029			
Seriama	0.1056	−0.0525			
Common Loon	0.1257	−0.0151			
White Pelican	0.0690	−0.0749			
Canada Goose	0.127	−0.0702			
Golden Eagle	0.1115	−0.0165			
Osprey	0.1070	−0.0209			
Ring-necked Pheasant	0.102	−0.0414			
Domestic Fowl	0.0797	−0.0351			
Sandhill Crane	0.1135	−0.0298			
Oyster-catcher	0.1253	−0.1752			
Lapwing	0.252	−0.1613			
Lesser Black-backed Gull	0.163	−0.0683	0.1835	−0.0683	−0.0524
Herring Gull	0.244	−0.0241	0.2718	−0.0241	−0.0729
European Common Gull	0.185	−0.1194	0.1928	−0.1194	−0.0204
Kittiwake	0.1634	−0.0883			
European Carrion Crow	0.177	−0.0853	0.1912	−0.0853	−0.0371
C					
Great Auk			0.3181	−0.0038	−0.1479

As previously mentioned, the "c" values are not fixed in a given species, or even in a given individual, but there are none the less certain general principles that may be noted. Most birds (species or individuals) have a negligible c_3 term and may be graduated as standard avians. The murre group have a very high c_1 and substantial c_3 term, but a very modest c_2. Struthious birds vary greatly in elongation or ellipticity (b/a ratio), generally have the two ends of the eggs so nearly alike that it is hard to guess which is the big end (c_1 very small), but the c_3 term is quite large, reaching an exceptional value in the Tinamou. This is obvious on mere inspection of the eggs of the last species.

On the other hand, it is not so obvious on mere inspection of the eggs of the Lapwing (say) that the c_3 term is even higher than in the Tinamou, because the characteristic plover shape, with one end of the egg enormous compared with the other, due to a high c_1 term, somewhat thoroughly disguises the biconical element.

Murres, which also have one very big and one very small end to their eggs, do not have this excessive c_2 component.

Many birds have so low a c_3 value (less than 0.050) that they may be regarded as virtually "simple ovals." Such species are the domestic fowl, Ring-necked Pheasant, Golden Eagle, Osprey, and Sandhill Crane.

The queer shape of the egg of the Red-throated Loon is due to a substantial *positive* c_3 term. In all other species so far examined, if c_3 is not negligible, it is negative.

In table 6, there are sometimes indicated optional ways of graduating the observations, using either the Standard Avian or Alcid formula. The formula actually used for comparison purposes in table 5 is indicated in that table.

Acknowledgements.—Dr. M. Graham Netting, Mr. W. E. Clyde Todd, and Mr. John Link were all very helpful in giving me access to the Carnegie Museum collection of eggs, and even in rearranging it for my greater convenience. Mrs. Effie Young of the Preston Laboratories computed all the parameters of actual eggs herein recorded, as well as many others. (The Great Auk's egg, involving the $\sin^4 \theta$ term, is a computation of my own using a different method.) Mr. George Wiest, also of this Laboratory, developed and made the profile-tracer and other contrivances used in this investigation.

I am indebted, too, to Professor R. C. F. Bartels of the University of Michigan for looking over the algebra and for suggesting, in two or three places, a phraseology that would convey the meaning more adequately.

Summary.—The meridian section or profile of eggs can be represented very easily and very accurately by an analytical expression. In the present paper we make use of a form of equation involving the "eccentric angle." In order of increasing complexity the forms described by this equation are the circle (sphere), ellipse (ellipsoid), simple oval, standard avian oval, and Alcid oval. The appropriate equations are derived, and a method of estimating the "adjustable constants" or parameters by the use of "Least Squares" on a practical basis is worked out. A comparison of observed and calculated values is tabulated for a considerable variety of species. Biological implications are left for a later paper.

A sequel to this paper, dealing with the variation of the shape of eggs according to their position in the clutch sequence, by F. W. and E. J. Preston, will appear later this month in the Annals of the Carnegie Museum.

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Preston Laboratories, Box 149, Butler, Pennsylvania, February 14, 1952.

THE SEVENTIETH STATED MEETING OF THE AMERICAN ORNITHOLOGISTS' UNION

BY ALBERT WOLFSON, SECRETARY

THE first meeting of the Union in the State of Louisiana was held at Baton Rouge, October 20 through 24, 1952, at the invitation of Louisiana State University and the Louisiana Ornithological Society. Headquarters were in Pleasant Hall on the campus of Louisiana State University. Business sessions were held in Pleasant Hall; public sessions were held in the Auditorium and Court Room of the Law Building and in the Auditorium of the Music and Dramatic Arts Building on the Campus.

BUSINESS SESSIONS

Business sessions were held as follows: (1) First Session of the Council, Monday, October 20, 9:00 a.m. to 12:35 p.m. Number in attendance, 17. (2) Second Session of the Council, Monday, 2:10 p.m. to 3:50 p.m. Number in attendance, 18. (3) Meeting of the Fellows, Monday, 4:00 p.m. to 5:30 p.m. Number in attendance, 34. (4) Meeting of the Fellows and Members, Monday, 8:30 p.m. to 12:45 a.m. Number in attendance, 69 (Fellows, 39; Members, 30). (5) Third Session of the Council, Wednesday, October 22, 8:10 a.m. to 8:50 a.m. Number in attendance, 17.

Reports of Officers. The Secretary reported that the total membership of the Union was 2,877, as of October 20, 1952. Membership by classes was as follows: Fellows, 69; Fellows Emeriti, 2; Honorary Fellows, 16; Corresponding Fellows, 66; Members, 184; Associates, 2,517; and Student Members, 23. Since the last meeting, 566 persons had been proposed for associate membership. Their election at this meeting brought the total membership to 3,443, the largest in the history of the Union, and an increase of 268 over last year. The previous highest total membership was 3,269 in October, 1950. The Secretary received from Dr. A. W. Schorger, Chairman of the Committee on Biography, notices of the death of the following members:

James Lee Peters, Fellow, April 19, 1952, at Cambridge, Massachusetts.

Dorothea Minola Bate, Corresponding Fellow, January 13, 1951, at Essex, England.

Joseph Scattergood Dixon, Life Member, June 23, 1952, at Escondido, California.

Eugene Edmund Murphey, Member, April 13, 1952, at Augusta, Georgia.

Earle Amos Brooks, Honorary Life Associate, April 4, 1952, at Newton, Massachusetts.

Charles Bradley Isham, Honorary Life Associate, November 17, 1951, at Hyannis, Massachusetts.

Mrs. Helen Granger Whittle, Life Associate, August 4, 1951, at Hillsboro, New Hampshire.

Mrs. Harriet Chapman Battel, Associate, October 24, 1951, at Paoli, Pennsylvania.
Donald Roland Bemont, Associate, March 28, 1951, at Ithaca, New York.
Frank Weston Benson, Associate, November 14, 1951, at Salem, Massachusetts.
Martin Joachim Burelbach, Associate, January 26, 1952, at Chattanooga, Tennessee.
John Lindsay Clark, Associate, December 12, 1951, at New York, New York.
Gus August Engeling, Associate, December 13, 1951, at Derden Wildlife Management Area, Anderson County, Texas.
Mary Louise Fossler, Associate, January 22, 1952, at Pasadena, California.
Victor Theodore Gaboriault, Associate, March 22, 1952, at Rigaud, Quebec.
Harry Lee Harllee, Associate, February 22, 1952, at Florence, South Carolina.
Edward King Hammond, Associate, September 29, 1950, at Chicago, Illinois.
Marian White Little, Associate, May 29, 1952, at Guilford, Connecticut.
Alice May MacQuarrie, Associate, January 23, 1951, at Pasadena, California.
Angie Kumlien (Mrs. Herbert) Main, Associate, August 30, 1952, at Fort Atkinson, Wisconsin.
Gertrude A. (Mrs. H. J.) Nunnemacher, Associate, October 31, 1950, at Milwaukee, Wisconsin.
Walter E Rogers, Associate, October 5, 1951, at Appleton, Wisconsin.
Samuel Robert Savage, Associate, January 31, 1952, at Overton, Texas.
Charles Edwin Shawen, Associate, August 24, 1951, at Dayton, Ohio.
Mrs. Lawrence P. Talley, Associate, July 29, 1951, at Brandywine Hundred, Delaware.
James David Whitaker, Associate, January 28, 1952, at Wellesley, Massachusetts.
Arthur Jason Woodward, Associate, March 18, 1952, at Clearwater, Florida.

The Treasurer gave his report, which will be published in the July issue of 'The Auk.'

Dr. Harvey I. Fisher, Editor of 'The Auk,' reported that there were enough manuscripts for the January number, but that in view of his pending resignation at the end of the current volume, he had been turning back manuscripts since last spring. Dr. Fisher expressed his appreciation of the generous assistance and cooperation of the members who had worked with him during his editorship, especially the members of the Committee on Illustrations, which has been under the Chairmanship of Dr. Milton B. Trautman since its inception two years ago. At the conclusion of his report Dr. Fisher submitted his resignation. The Council, in accepting his resignation, extended to him its deep appreciation for his fine work and four years of service.

Reports of Committees. The Chairman of the Committee on Endowment, Mrs. Betty Carnes, reported the following results: Life Members, $975.00; Patrons, $1,800.00; endowment funds transferred from the Canadian account, $1,558.30; gifts, $670.00—a total endowment increase of $5,003.30.

The report of the Special Canadian Committee was given by Mr. Hoyes Lloyd, Chairman. By mid-January of 1951, the Canadian and United States dollars having reached equality, President Van Tyne, acting on the advice of the Finance Committee and this Committee,

asked that the funds in charge of this Committee be transferred to the Treasurer. The main transfer occurred on January 22, 1952. Total assets in Canada, as of August 15, 1952, were $5.53. On recommendation of the Committee, the Council voted to reduce the Committee to one member, to serve until the Canadian account is closed in about six months, and to discontinue the work of the Committee after that time. The Council, in accepting the Committee's report expressed its thanks to Mr. Lloyd for his great service to the Union as Chairman of this Committee for the past several years.

Dr. Alexander Wetmore, Chairman of the Committee on Classification and Nomenclature of North American Birds, reported that the Committee prepared in draft form a revision of the ranges of the families Ploceidae, Icteridae, Thraupidae, and Fringillidae (through the genus *Loxia*) for circulation among its collaborators for criticism and comment. There remain 49 species in the Fringillidae of which about two-thirds have been completed. The Committee considered 48 cases of proposed change in scientific name or status, new forms, and revival of forms not currently recognized. Thirty-six changes were approved and were published in 'The Auk' (July, 1952) as the Twenty-seventh Supplement to the Check-List. The Committee continued to employ Mr. E. M. Reilly to assemble records from the files of the Fish and Wildlife Service and from the literature, for use in the preliminary preparation of range material. The cost of this service, which amounts to $15,308.30 to date, has been met through research grants from the Smithsonian Institution. The expense involved in the typing, mimeographing, and mailing of range material to collaborators, and the considerable correspondence of the Chairman and Vice-Chairman were met also by the Smithsonian Institution.

According to Dr. Albert Wolfson, Chairman, the Committee on Research continued its established program and hoped to conclude two of its projects during the coming year, the publication of a list of unpublished theses in ornithology and a book on recent research in ornithology.

Following the procedure of previous years, the Committee on Education, under the Chairmanship of Dr. William H. Behle, distributed application blanks for student membership awards to 88 regional representatives. Dr. Behle reported that 23 applications were received. Since sufficient funds were available, all applications were granted. The list of recipients was published in the April (1952) issue of 'The Auk.'

Mr. C. K. Nichols, Editor of the 'Ten-year Index to The Auk,' reported that indexing has been completed with the exception of a

short list of reviews which require reference to the original source. Typing of the manuscript is under way and is expected to be completed during the coming year.

Work on the 'Handbook of North American Birds,' sponsored by the Union with Dr. Ralph S. Palmer as Editor, is progressing. Within a few months a preliminary outline for treatment of species will be circulated for comment and criticism. Dr. Palmer is trying to conclude his prior commitments as rapidly as possible in order to devote more time to the 'Handbook.' Dr. Palmer reported that the geographical area included in the Check-List is so large and diverse that it may be impossible to find anyone who is competent to cover one topic for all of the birds occurring in it. This means that more collaborators may be needed and may result in slower progress. It may be necessary, and it certainly is desirable, to obtain a grant from some foundation for financing certain aspects of the project.

The Award of the Brewster Medal. The 1952 Brewster Medal was awarded, by action of the Council, to Dr. John T. Zimmer of the American Museum of Natural History for his research on the systematics and distribution of South American birds, especially those of Peru. The Committee's report states: "His series of reports beginning in 1931 and continuing up to the present (nos. 51–61, 1946–1951) have appeared in the American Museum Novitates under the general title of 'Studies of Peruvian Birds.' They have embodied extremely thorough and sound taxonomic treatment of a large proportion of the genera of birds in South America. These reports are truly the foundation for the work of all other current students of the South American avifauna. They are characterized by precision, good taxonomic judgment, and comprehensiveness."

Next Stated Meeting. Fellows and Members, meeting together, accepted the invitation of the Los Angeles County Museum to hold the Seventy-first Stated Meeting in Los Angeles in October, 1953.

Amendments to the By-Laws. Three amendments to the By-Laws were given final approval by the Fellows. Associates may now be elected during the year as well as at the annual meeting, and ornithologists in the Americas outside of the United States and Canada may be elected to the classes of Fellows and Members. (For a detailed listing of the three amendments, see 'The Auk,' 69: 70, January, 1952.)

Miscellaneous Matters. The Committee on Education was renamed the Committee on Student Membership Awards and the Committee on Bird Protection was renamed the Advisory Committee on Bird Protection.

Mrs. Herbert E. Carnes of Tenafly, New Jersey, and Mrs. Carll Tucker of New York City became Patrons of the Union.

ELECTION OF OFFICERS

The following officers were elected for 1952–53: ***President***, Josselyn Van Tyne; *Vice-Presidents*, Alden H. Miller and Ludlow Griscom; *Secretary*, Albert Wolfson; *Treasurer*, R. Allyn Moser. ***Elective Members of the Council:*** Jean Delacour, Harvey I. Fisher, Herbert L. Stoddard.

The Council elected Robert W. Storer, *Editor* of 'The Auk;' Frederick V. Hebard (Chairman), G. Ruhland Rebmann, Jr., and Phillips B. Street, *Investing Trustees.*

ELECTION OF FELLOWS, MEMBERS, AND ASSOCIATES

FELLOWS—6

Emmet Reid Blake, Chicago, Illinois.
Paul Lester Errington, Ames, Iowa.
Elsie Margaret Binger Naumburg, New York, New York.
William Henry Phelps, Sr., Caracas, Venezuela.
Robert Winthrop Storer, Ann Arbor, Michigan.
Albert Wolfson, Evanston, Illinois.

CORRESPONDING FELLOWS—4

Armando Dugand, Colombia.
Jack William Davies Goodall, Santiago, Chile.
Alfred William Johnson, Santiago, Chile.
Rodulfo Amando Philippi B., Santiago, Chile.

MEMBERS—12

William J. Baerg, Fayetteville, Arkansas.
Andrew John Berger, Ann Arbor, Michigan.
William Bertram Cartwright, Manitoba, Canada.
Howard L. Cogswell, Berkeley, California.
Joshua Clifton Dickinson, Jr., Gainesville, Florida.
Harold Carsten Hanson, Urbana, Illinois.
Margaret Brooks Hickey, Madison, Wisconsin.
M. Brooke Meanley, Baltimore, Maryland.
Robert James Newman, Baton Rouge, Louisiana.
Raymond Andrew Paynter, Jr., New Haven, Connecticut.
Phillips Borden Street, Philadelphia, Pennsylvania.
George Guion Williams, Houston, Texas.

ASSOCIATES—566

ATTENDANCE

Registration at the meeting showed an attendance of 195, composed of 4 Patrons, 38 Fellows, 46 Members, and 107 Associates. Represented were 33 states, the District of Columbia, one province of Canada (Ontario), Brazil, Puerto Rico, and Venezuela. Attendance of 93 guests brought total registration to 288.

PATRONS, FELLOWS, MEMBERS, AND ASSOCIATES PRESENT

PATRONS:—Betty Carnes, Hoyes Lloyd, Mrs. Dayton Stoner, Mrs. Carll Tucker.

FELLOWS:—John W. Aldrich, Dean Amadon, Oliver L. Austin, Jr., William H. Behle, Walter J. Breckenridge, Maurice Brooks, James P. Chapin, Jean Delacour, John Emlen, Harvey I. Fisher, Herbert Friedmann, Ira N. Gabrielson, James Greenway, Ludlow Griscom, Edwin R. Kalmbach, Frederick C. Lincoln, George H. Lowery, Jr., Alden H. Miller, Robert Cushman Murphy, Mrs. Margaret M. Nice, Harry C. Oberholser, Eugene P. Odum, Olin Sewall Pettingill, Jr., William H. Phelps, Sr., Austin L. Rand, S. Dillon Ripley, Aretas A. Saunders, A. W. Schorger, Lester L. Snyder, Alexander Sprunt, Jr., Herbert L. Stoddard, Robert W. Storer, George M. Sutton, Josselyn Van Tyne, Lawrence H. Walkinshaw, Alexander Wetmore, Albert Wolfson, John T. Zimmer.

MEMBERS:—Anders H. Anderson, John H. Baker, A. Marguerite Baumgartner, Pierce Brodkorb, Ben B. Coffey, Jr., Allan Cruickshank, David E. Davis, J. C. Dickinson, Jr., Eugene Eisenmann, Albert F. Ganier, Stephen S. Gregory, Earle R. Greene, Samuel Grimes, Owen Gromme, William W. H. Gunn, Harry W. Hann, Frederick V. Hebard, Joseph Howell, Laurence M. Huey, P. P. Kellogg, Junea W. Kelly, Amelia R. Laskey, J. Stokley Ligon, Joe T. Marshall, Jr., Harold Mayfield, Robert McCabe, M. Brooke Meanley, Robert Mengel, Burt L. Monroe, R. Allyn Moser, Robert Newman, Ralph S. Palmer, Raymond A. Paynter, Jr., Harold S. Peters, William H. Phelps, Jr., Allan R. Phillips, Karl Plath, Richard H. Pough, William F. Rapp, Jr., Gustav A. Swanson, James T. Tanner, George J. Wallace, Dwain W. Warner, Francis M. Weston, George G. Williams, Lloyd R. Wolfe.

ASSOCIATES:

Alabama, 1—Mrs. Blanche E. Dean, Birmingham.

Arizona, 1—Lyndon L. Hargrave, Benson.

Arkansas, 2—Arnold J. Hoiberg, El Dorado; Howard Young, Fayetteville.

California, 7—Enid K. Austin, Oakland; Ethel M. Dixon, Escondido; J. B. Dixon, Escondido; Lynn Foree, Oakland; Thomas R. Howell, Los Angeles; William Sheffler, Los Angeles; Kenneth E. Stager, Los Angeles.

Colorado, 1—Paul Baldwin, Fort Collins.

Florida, 7—Marjorie Briggs, Gainesville; Robin Cooley, Gainesville; Conrad H. Ekdahl, Daytona Beach; Merritt Farrar, Winter Park; David Karraker, Gainesville; Henry M. Stevenson, Tallahassee; Louis A. Stimson, Miami.

Georgia, 1—Leon Neel, Thomasville.

Illinois, 4—Mrs. Harry L. Baldwin, Chicago; Karl E. Bartel, Blue Island; Donald Goodman, Urbana; Douglas James, Champaign.

Kentucky, 2—Leonard C. Brecher, Louisville; Mrs. F. W. Stamm, Louisville.

Louisiana, 30—William H. Baughn, Baton Rouge; Mrs. William H. Baughn, Baton Rouge; Leslie Brown, Baton Rouge; James Henry Bruns, St. Francisville; Fred J. Buchmann, Baton Rouge; Mrs. C. L. Casey, Shreveport; Joe Cleaton, New Orleans; Mary Cleaton, New Orleans; Hoyt Cragg, Baton Rouge; Frances R. Crews, Baton Rouge; Penny A. Daigre, Baton Rouge; J. L. Dorn, New Orleans; Francis B. Eastman, Mandeville; Marshall B. Eyster, Lafayette; Rose Feingold, New Orleans; G. Dale Hamilton, Shreveport; Ethel Hanchey, Baton Rouge; Horace Jeter, Shreveport; Kathleen Key, Pineville; Mrs. R. W. Krebs, Baton Rouge; Virgil Lapham, Pilot Town; Robert B. Lea, New Orleans; Robert B. Moore, Baton Rouge; Bertha H. Morere, New Orleans; Rossiter D. Olmstead, New Orleans; J. Harvey Roberts, Baton Rouge; Charles R. Shaw, Pineville; Lonnie M. Sibley, Grand Chenier; Frederick Webert, Grand Chenier; H. Brainard Wright, Shreveport.

Maine, 1—F. Burton Whitman, Jr., Brunswick.
Massachusetts, 2—Dorothy E. Snyder, Salem; David K. Wetherbee, Worcester.
Michigan, 5—Philip Humphrey, Ann Arbor; Edith K. Frey, Jackson; Mrs. Josselyn Van Tyne, Ann Arbor; Harold F. Wing, Jackson; Ruth S. Wing, Jackson.
Mississippi, 2—Fannye A. Cook, Jackson; Gene Thompson Hendricks, Brookhaven.
Nevada, 1—Warren Pulich, Boulder City.
New Jersey, 1—Helen J. Williams, East Orange.
New York, 4—Winston Brockner, Buffalo; Ruth T. Chapin, New York City; Mrs. Grace E. Barstow Murphy, New York City; Jason A. Walker, Waterloo.
Ohio, 1—Betsy Tucker, Cincinnati.
Oklahoma, 7—Frederick M. Baumgartner, Stillwater; Joe C. Creager, Ponca City; Richard Graber, Norman; John C. Johnson, Jr., Norman; Dolores Mayfield, Norman; David Parmelee, Norman; Mrs. Lovie M. Whitaker, Norman.
Ontario, 2—Bertram A. Fauvel, Ottawa; Wilmot Lloyd, Ottawa.
Pennsylvania, 3—John Cairns, Scranton; Robert W. Glenn, Pittsburgh; Henry T. Underdown, Elkins Park.
Tennessee, 1—Mrs. E. W. Goodpasture, Nashville.
Texas, 11—Paul S. Baker, Dallas; L. Irby Davis, Harlingen; Keith L. Dixon, College Station; Pauline James, Kingsville; Edgar Kincaid, Austin; Mrs. T. C. Lacey, Nacogdoches; Charles H. McNeese, Houston; Mrs. Selby O'Neil Novah, Commerce; Bessie M. Reid, Silsbee; Whitfield Leggett Russell, Rhome; Frank G. Watson, Houston.
Virginia, 1—Ernest Edwards, Amherst.
Washington, D. C., 1—Charles H. M. Barrett.
Wisconsin, 5—Lois Almon, Eau Claire; John L. Kaspar, Oshkosh; Wesley Lanyon, Madison; Margarette E. Morse, Viroqua; Helmut C. Mueller, Milwaukee.
Brazil, 1—Margaret H. Mitchell, Rio de Janeiro.
Puerto Rico, 1—Virgilio Biaggi, Jr., Mayaguez.
Venezuela, 1—Kathleen D. Phelps, Caracas.

PUBLIC SESSIONS

Six public sessions were held, two on Tuesday, one on Wednesday, and three on Thursday. Four of these sessions were concerned entirely with the reading of papers. The session on Wednesday morning was devoted partly to papers and partly to a panel discussion; the session on Thursday afternoon was devoted entirely to the showing of motion pictures. An outline of the program is presented below. Titles marked with an asterisk were illustrated by lantern slides.

TUESDAY MORNING SESSION

Welcome by GENERAL TROY H. MIDDLETON, President, Louisiana State University.
Response on behalf of The American Ornithologists' Union.
Report on the Business Meetings; Announcements of the Results of Elections and the Brewster Memorial Award.
Announcements from the Local Committee on Arrangements.
*A Venezuelan Reconnaissance, with Particular Reference to the Caribbean Islands. ROBERT CUSHMAN MURPHY, American Museum of Natural History, New York City.

Report on the Third General Assembly of the International Union for the Protection of Nature. RICHARD H. POUGH, American Museum of Natural History, New York City.

What Constitute Scientific Data for the Study of Bird Distribution? JOSSELYN VAN TYNE, University of Michigan Museum of Zoology, Ann Arbor.

*The Nature of the Pairing Bond in Certain Birds. JOHN T. EMLEN, JR., University of Wisconsin, Madison.

Progress Report on the Handbook of North American Birds. RALPH S. PALMER, New York State Museum, Albany.

TUESDAY AFTERNOON SESSION

A Five-Year Study of Winter Harris's Sparrows. A. MARGUERITE BAUMGARTNER, Stillwater, Oklahoma.

Incubation Periods Throughout the Ages MARGARET M. NICE, Chicago, Illinois.

*The Olfactory Senses of Cathartid Vultures. KENNETH E. STAGER, Los Angeles County Museum.

*Measurement of Territory Size in Birds. EDWARD J. KUENZLER, JR. and EUGENE P. ODUM, University of Georgia, Athens.

*Mechanically Recorded Nocturnal Unrest in Captive Songbirds. MARSHALL B. EYSTER, Southwestern Louisiana Institute, Lafayette.

*The Effect of Diet on Photoperiod-Induced Fat Deposition in the White-throated Sparrow. EUGENE P. ODUM and JAMES C. MAJOR, University of Georgia, Athens.

The Occurrence and Regulation of the Refractory Period in the Gonadal and Fat Cycles of the Junco. ALBERT WOLFSON, Northwestern University, Evanston, Illinois.

*The Relative Importance of the Trans-Gulf and Circum-Gulf Spring Migrations. HENRY M. STEVENSON, Florida State University, Tallahassee.

*Racial and Sexual Differences in Migration in *Sphyrapicus varius*. THOMAS R. HOWELL, University of California, Los Angeles.

Can the Universal Interest in Aeronautics Be Made to Serve the Cause of Bird Protection? GRACE E. BARSTOW MURPHY, New York City.

The Cooperative Mourning Dove Study. HAROLD S. PETERS, U. S. Fish and Wildlife Service, Atlanta, Georgia.

WEDNESDAY MORNING SESSION

Painting Georgia Birds on Location. GEORGE MIKSCH SUTTON, University of Oklahoma, Norman.

*Seven More Milliseconds in the Lives of Common Birds. ARTHUR A. ALLEN, Laboratory of Ornithology, Cornell University, Ithaca.

*Habitat Types at Churchill, Manitoba. HAROLD MAYFIELD, Toledo, Ohio.

*Nesting of Sea-Ducks at Igiak Bay, Alaska. PHILIP S. HUMPHREY, University of Michigan Museum of Zoology, Ann Arbor.

PANEL DISCUSSION

COMPARATIVE BIOLOGY OF THE GENUS *Empidonax*

Chairman: DAVID E. DAVIS, The Johns Hopkins University, Baltimore, Maryland.

Participants: ALLAN R. PHILLIPS, Tucson, Arizona; DAVID E. DAVIS; A. A. SAUNDERS, Canaan, Connecticut; JOHN W. ALDRICH, Fish and Wildlife Service, Washington, D. C.; PIERCE BRODKORB, University of Florida, Gainesville.

THURSDAY MORNING SESSION

SECTION A

*Some Observations on the Population Changes in Birds from One Year to the Next. J. C. HOWELL, University of Tennessee, Knoxville.

Recent Changes in the Status of Certain Birds in Oklahoma. F. M. BAUMGARTNER, Oklahoma Agricultural and Mechanical College, Stillwater.

Geographical Variation in the Songs and Calls of Birds. ARETAS A. SAUNDERS, Canaan, Connecticut.

On the Possibility of Taxonomic Hints from Sound Recordings. L. IRBY DAVIS, Harlingen, Texas.

Nesting of the Hooded Merganser. DAVID F. PARMELEE, University of Oklahoma, Norman.

Notes on Birds of the Big Bend Country of Texas. LOVIE M. WHITAKER and LENA G. MCBEE, Norman, Oklahoma and El Paso, Texas.

History of Ornithological Work at the University of Oklahoma. JOHN C. JOHNSON, University of Oklahoma, Norman.

*Censusing Southern Michigan Sandhill Cranes—1952. HAROLD WING and LAWRENCE H. WALKINSHAW, Jackson and Battle Creek, Michigan.

*Roosting Behavior of Blackbirds in the Arkansas Rice Fields. BROOKE MEANLEY, U. S. Fish and Wildlife Service, Stuttgart, Arkansas.

A Distributional List, with Suggested English Names, for the Species of Middle American Birds. EUGENE EISENMANN, Linnaean Society of New York, New York.

*The Duck Decoy Trap as a Technique in Waterfowl Research. ROBERT A. MCCABE and NAN MULDER, Delta Waterfowl Research Station, Delta, Manitoba.

SECTION B

A Fossil Hoatzin from the Miocene of Colombia. ALDEN H. MILLER, Museum of Vertebrate Zoology, University of California, Berkeley.

*Daily Activity Periods of Birds in Relation to Light Intensity. MARJORIE A. BRIGGS, University of Florida, Gainesville.

*The Plumage Cycle of the California Gull (*Larus californicus*). WILLIAM H. BEHLE and ROBERT K. SELANDER, University of Utah, Salt Lake City.

*Variation with Day Length and Temperature of the Nesting Time of Juncos. James T. TANNER, University of Tennessee, Knoxville.

*Birds of Pine-oak Woodland in Arizona and Adjacent Mexico. JOE T. MARSHALL, JR., University of Arizona, Tucson.

*An Analysis of the Avifauna of the Coastal Lowlands of Michoacan and Guerrero. ROBERT W. STORER, University of Michigan Museum of Zoology, Ann Arbor.

The Manx Shearwater (*Puffinus puffinus*), a Species of Worldwide Distribution. ROBERT CUSHMAN MURPHY, American Museum of Natural History, New York City.

*An Analysis of the Interbreeding of the Tufted and Black-crested Titmice in Texas. KEITH L. DIXON, Agricultural and Mechanical College of Texas, College Station.

Migratory Birds of Relict Distribution—Some Inferences. DEAN AMADON, American Museum of Natural History, New York City.

Comments on *Dendroica dominica stoddardi*. GEORGE MIKSCH SUTTON, University of Oklahoma, Norman.

*Ecologic Aspects of Evolution in the Hawaiian Honeycreepers. PAUL H. BALDWIN, Colorado A. & M. College, Fort Collins.

THURSDAY AFTERNOON SESSION

MOTION PICTURES

Behind the Flyways (U. S. Fish and Wildlife Service). FREDERICK C. LINCOLN, U. S. Fish and Wildlife Service, Washington, D. C.

Wandorobo (By Edgar M. Queeny). JAMES P. CHAPIN, American Museum of Natural History, New York City.

The Pelicans of Last Mountain. FRED G. BARD, Provincial Museum, Regina, Saskatchewan.

Water Birds (Walt Disney Productions). KENNETH E. STAGER, Los Angeles County Museum.

OTHER EVENTS

On Monday evening, a dinner for the Fellows was given by the Local Committee in the Louisiana State University Faculty Club. Forty-four fellows attended. Following the dinner, Dr. and Mrs. Van Tyne entertained over 200 members and guests of the Union at a reception in the main lounge of the Faculty Club.

Approximately 275 ornithologists and their friends visited the Museum of Zoology on Tuesday evening as guests of the University and the Louisiana Ornithological Society. This event marked the official opening of an exhibit of recent paintings of southern birds, composed of the works of John Henry Dick and Richard Parks, together with George Miksch Sutton's illustrations for T. D. Burleigh's forthcoming "Birds of Georgia." Guests at this reception spent much time examining the research collections in the Museum.

An innovation at A.O.U. meetings was the interruption of the papers sessions on Wednesday afternoon to permit a field trip and general outing. Approximately 225 members and guests motored to the Audubon State Park at Oakley, 35 miles north of Baton Rouge, where a barbecue was served on the grounds of this beautiful ante-bellum home—the one-time abode of John James Audubon.

On Thursday evening, 224 members and guests attended the Annual Banquet in the Sky Room of the Heidelberg Hotel, in downtown Baton Rouge. Entertainment was provided by Mr. Justin Wilson, who is famous for his Cajun stories, and by Mr. Walt Kelly, creator of the celebrated *Pogo*.

Friday was devoted to a field trip to Grand Isle, on the coast of Louisiana. Chartered busses and private cars conveyed the exceptionally large aggregation of approximately 160 members and guests on this 330-mile trip, which was highlighted by a fine view of the famous Louisiana marshes and the picturesque bayou country. Species observed that were especially interesting to many visitors were the Arkansas Kingbird, Man-o'-war-bird, and the Cabot's Tern.

During the week numerous small groups of visiting ornithologists were taken to fields below the University campus where they were shown Yellow Rails and given demonstrations of the technique of catching the birds alive by hand. In all, six individuals were so captured on the various excursions during the week.

Special features for the wives of visiting ornithologists included a luncheon at the Esso Standard Oil Plant, a tour of the Louisiana State Capitol, and visits to historic southern homes in the vicinity of St. Francisville. They were also entertained by the First Lady of Louisiana, Mrs. Robert F. Kennon, at the Governor's Mansion.

RESOLUTIONS

At the meeting of the Council on Monday morning the following resolution was passed:

Resolved, that the Council of the American Ornithologists' Union in session at the Seventieth Stated Meeting at Baton Rouge, Louisiana, express formally to Dr. Theodore S. Palmer, long an honored Fellow of our Society, its sincere thanks for his valuable assistance, through further contribution of funds for the publication of *The Auk*. This particularly has enabled the editor of the Union to keep current the publication of useful biographical records on deceased members and has added importantly to the pages of our publication.

At the public session on Thursday afternoon, the following resolutions were passed:

Resolved, that we express the deep appreciation of The American Ornithologists' Union to William H. Baughn, Fred J. Buchmann, Robert W. Krebs, Mrs. Robert B. Moore, Robert B. Moore, Robert J. Newman, J. Harvey Roberts, O. W. Rosewall, and George H. Lowery, Jr., Chairman of the Local Committee on Arrangements, for the careful planning and considerable work that have made our first Louisiana meeting so successful.

Be it further resolved, that we express the gratitude of The American Ornithologists' Union to Louisiana State University for its gracious hospitality and the use of its excellent facilities, and to members of the Louisiana Ornithological Society for their great generosity and many kindnesses in arranging for the Seventieth Stated Meeting.

Be it finally resolved, that we express the thanks of The American Ornithologists' Union to the Louisiana Ornithological Society, the National Audubon Society, the Louisiana Wildlife Federation, and the Louisiana State Parks Commission for the superb barbecue served to our members and guests on the grounds at Oakley.

OFFICERS, TRUSTEES, AND COMMITTEES OF THE AMERICAN ORNITHOLOGISTS' UNION

Expiration of Term

Josselyn Van Tyne, *President* 1953
Alden H. Miller, *First Vice-President* 1953
Ludlow Griscom, *Second Vice-President* 1953
Albert Wolfson, *Secretary* 1953
R. Allyn Moser, *Treasurer* 1953
Robert W. Storer, *Editor of 'The Auk'* 1953

ELECTIVE MEMBERS OF THE COUNCIL

W. J. Breckenridge 1953
George H. Lowery, Jr. 1953
L. L. Snyder 1953
Dean Amadon 1954
Harrison F. Lewis 1954
Olin Sewall Pettingill, Jr. 1954
Jean Delacour 1955
Harvey I. Fisher 1955
Herbert L. Stoddard 1955
Frank A. Pitelka, *Cooper Ornithological Society Representative* 1953
Burt L. Monroe, *Wilson Ornithological Club Representative* 1953

Charles F. Batchelder, 1905–8
Arthur Cleveland Bent, 1935–37
James P. Chapin, 1939–42
Herbert Friedmann, 1937–39
Hoyes Lloyd, 1945–48
Robert Cushman Murphy, 1948–50
Alexander Wetmore, 1926–29
} *Ex-Presidents*

INVESTING TRUSTEES

Frederick V. Hebard, *Chairman* 1953
G. Ruhland Rebmann, Jr. 1953
Phillips B. Street 1953

COMMITTEES

COMMITTEE ON FINANCE. R. Allyn Moser, *Chairman*. Stephen S. Gregory, Burt L. Monroe, Albert Wolfson, Josselyn Van Tyne.

COMMITTEE ON ENDOWMENT. Betty Carnes (Mrs. Herbert E.), *Chairman*. (Membership to be announced later.)

SPECIAL CANADIAN COMMITTEE. Hoyes Lloyd.

COMMITTEE ON PUBLICATIONS. The Editor of 'The Auk,' *Chairman*. The President, the Secretary, the Treasurer, the Editor of 'The Ten-year Index to The Auk' (Charles K. Nichols), Alden H. Miller.

COMMITTEE ON COMMUNICATIONS. Albert Wolfson, *Chairman*. Frank A. Pitelka, George H. Lowery, Jr.

EDITORIAL COMMITTEE. Robert W. Storer, *Chairman*. Andrew J. Berger, John T. Emlen, Jr., Harvey I. Fisher, Philip S. Humphrey, Peter Stettenheim.

COMMITTEE ON THE BREWSTER MEMORIAL AWARD. Ludlow Griscom, *Chairman*. James Bond, Margaret M. Nice, Robert W. Storer, Harrison B. Tordoff.

COMMITTEE ON BIOGRAPHY. A. W. Schorger, *Chairman*. Jean Delacour, Donald S. Farner, David L. Garrison, Hildegard Howard, T. S. Palmer, J. Murray Speirs.

COMMITTEE ON THE NOMINATION OF FELLOWS AND MEMBERS. Frank A. Pitelka, *Chairman*. Olin S. Pettingill, Jr., George H. Lowery, Jr.

COMMITTEE ON THE NOMINATION OF ASSOCIATES. Aaron M. Bagg, *Chairman*. William F. Rapp, Jr., *Vice-Chairman*. (Membership to be announced later.)

COMMITTEE ON CLASSIFICATION AND NOMENCLATURE OF NORTH AMERICAN BIRDS. Alexander Wetmore, *Chairman*. Herbert Friedmann, *Vice-Chairman*, Frederick C. Lincoln, Alden H. Miller, Josselyn Van Tyne, John T. Zimmer.

ADVISORY COMMITTEE ON BIRD PROTECTION. Ira N. Gabrielson, *Chairman*. Ludlow Griscom, Hoyes Lloyd.

COMMITTEE ON RESEARCH. Albert Wolfson, *Chairman*. Donald S. Farner, Herbert Friedmann, S. Charles Kendeigh, Ernst Mayr, Alden H. Miller, Margaret M. Nice.

COMMITTEE ON STUDENT MEMBERSHIP AWARDS. William H. Behle, *Chairman*. James L. Baillie, Jr., John T. Emlen, Jr., Joseph C. Howell, Charles G. Sibley.

LOCAL COMMITTEE ON ARRANGEMENTS for the Seventy-first Stated Meeting. Jean Delacour, *Chairman*. Vernon Barrett, John Davis, Walt Disney, C. V. Duff, Wade Fox, Ed N. Harrison, Hildegarde Howard, Thomas R. Howell, Earle R. Greene, Robert T. Moore, J. R. Pemberton, Sidney B. Peyton, Howard Robertson, W. J. Sheffler, Kenneth E. Stager, Ray Thomas, J. C. von Bloeker, Jr., R. B. von KleinSmid.

RADIOSURGERY AND UPTAKE OF RADIOACTIVE IODINE BY THE THYROID OF THE OREGON JUNCO

BY ROBERT E. BAILEY

In recent years numerous advances in the study of the thyroid gland have been made through the use of radioactive iodine. These techniques are possible because the thyroid cells absorb iodine from the blood stream and utilize it in the synthesis of thyroxin. When radioactive iodine is injected or given in food it accumulates in the thyroid in the same manner as stable iodine and in appropriately strong dosages results in complete destruction of the thyroid cells without damaging the parathyroid or surrounding tissues (Goldberg *et al.*, Endocrinology, 46: 72–90, 1950). When used in this manner, radioactive iodine provides a simple technique for physiologically thyroidectomizing an animal and is even capable of destroying small islets of thyroid tissue not associated with the main mass. In smaller dosages no apparent damage to the thyroid cells can be observed, and thus the uptake and retention of radioactive iodine can be used as a means of evaluating thyroid function.

Because several important phenomena, such as molt, feather pigmentation, and fat deposition, are associated with thyroid function, this technique should be useful to ornithologists, especially those working with small birds in which surgical thyroidectomy is difficult or impractical. This paper deals with experiments using iodine-131 for destroying the thyroid cells and on the uptake and retention of a small dose of iodine-131 by the thyroid of the Oregon Junco (*Junco oreganus*).

METHODS

The Oregon Juncos used in these experiments were trapped on the University of California campus, Berkeley, California. They were confined in cages 12 by 18 by 36 inches and provided with ample seed and water. Iodine-131, provided in the form of a carrier-free saline solution, was diluted with 0.85 per cent NaCl to the appropriate strength and administered as a single intraperitoneal injection.

For the radiosurgery three groups of four birds each were injected on February 25, 1952, with 100, 200, and 400 microcuries of iodine-131, respectively. One group of four was kept as controls and one bird was injected with 50 microcuries. One bird from each group was autopsied 7, 18, 43, and 100 days after the injection. The thyroid, parathyroid, and surrounding tissue were removed, fixed in Bouin's fluid, sectioned serially, and stained with hematoxylin and eosin.

To study the uptake and retention of iodine-131, 17 Oregon Juncos were injected with 4.3 microcuries on January 29, 1952. At intervals of 3, 6, 11, 23, 53, 79, 104, and 125 hours after the injection one to three birds were sacrificed and examined. Both thyroid glands of each bird were dissected out, placed in a graduated tube, and dissolved in one-half cc. of 1N NaOH by gentle heating. At the end of the experiment all of the tubes were diluted with distilled water to 5 cc., and in addition two control tubes, containing the equivalent of 4.3 microcuries of the original iodine-131 solution, were prepared. One-half cc. was pipetted from each tube and placed on a copper disk. After the mixture on the disks had been dried under a heat lamp, the amount of radiation was determined with a Geiger counter. From a comparison of the radioactivity of the dissolved thyroid glands with the activity of the control tubes, the percentage of iodine-131 taken up and retained by the thyroids was calculated.

RESULTS: RADIOSURGERY

50 microcuries.—The one bird injected with 50 microcuries of iodine-131 was autopsied at the end of 100 days. The gland appeared normal in gross examination, but microscopic sections showed that the cellular arrangement of the glands had been disturbed. To a large degree the cells were not arranged in follicles, and there were no colloid deposits. In the center of the glands small nests of thyroid cells were located among areas of dense connective tissue, and there were numerous small blood vessels. The cells around the periphery were more normal in appearance, sometimes arranged in follicles but greatly hypertrophied.

100 microcuries.—The thyroids of the birds injected with 100 microcuries were severely damaged. On the 7th day the glands were edematous and swollen. Microscopic sections showed that most of the thyroid cells had been destroyed although a few small cells with pycnotic nuclei and reduced cytoplasm were observed at the periphery. The outlines of the follicles could still be seen in places, but for the most part the interior of the gland was infiltrated by fibrin, numerous blood cells, and macrophages. On the 18th day, a number of healthy thyroid cells was observed at the periphery of the gland. In the center, the outlines of the follicles had disappeared completely, and between the numerous blood sinuses, whorls of new connective tissue infiltrated with leukocytes and fibroblasts appeared.

By the 43rd day the gross appearance of the glands was normal and eventual recovery seemed probable. The number of healthy thyroid cells had increased greatly around the periphery, where they occurred as small nests surrounded by a dense network of distended blood

vessels (fig. 2). These cells were greatly hypertrophied and occasionally mitotic figures could be found. The center of the glands contained fewer blood vessels and more connective tissue than at 18 days. On the 100th day the layer of thyroid cells around the periphery had increased in width and contained many large active cells. Although they were still arranged in small groups somewhat similar to the normal follicles, no true follicles or colloid deposits were seen. The interior of the gland consisted of a diffuse collagenous stroma permeated with a few blood vessels, but with a marked reduction in the number of macrophages and free leukocytes.

200 and 400 microcuries.—The effects of 200 and 400 microcuries were almost identical: in each case the complete destruction of the thyroid cells. The gross and microscopic appearance of the glands went through cycles very similar to that caused by 100 microcuries. At first the glands were swollen and dark red in color. The vesicular arrangement of the cells was destroyed and replaced by a network of blood sinuses interspersed with newly formed connective tissue. 43 days after the injection the thyroid glands were much smaller than normal and were a dark purple color, and the number of large blood vessels and blood sinuses began to decrease. After 100 days the gland was composed of a dense connective tissue infiltrated with macrophages and leukocytes and a few small blood vessels (fig. 3). No normal thyroid cells were found in any of the glands of birds treated with 200 or 400 microcuries.

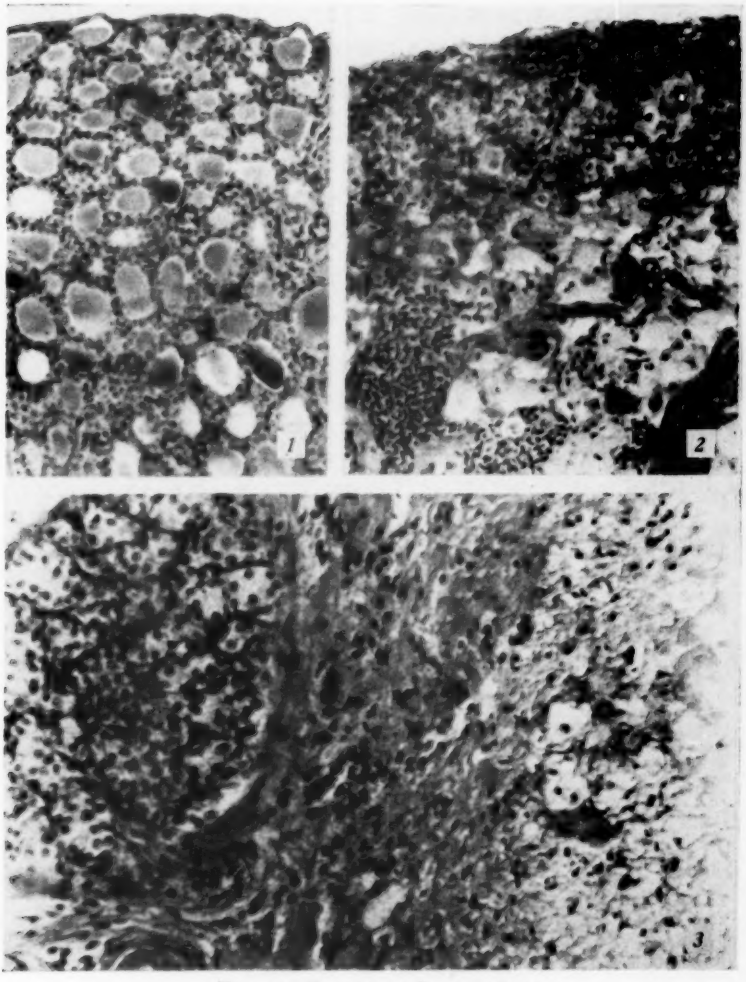
Parathyroid.—No damage to the parathyroid (fig. 3) or other tissues was observed in any of the birds regardless of the dosage or interval after the injection.

Uptake and Retention of Iodine-131

The uptake and retention of a single injection of 4.3 microcuries of iodine-131 is shown in figure 4. The injected iodine-131 was absorbed rapidly by the thyroid cells, and after 53 hours about 80 per cent of the amount administered was found to have accumulated in the glands. The release of the iodine-131 was almost as rapid as the absorption and by the fifth day only about 20 per cent was still present in the thyroid glands.

Discussion

The results of these experiments show that 200 microcuries of iodine-131 is sufficient to destroy the thyroid cells of an Oregon Junco for at least 100 days and that no damage, even with 400 microcuries, is done to the parathyroid or surrounding tissues. The birds weighed approximately 17 grams (range 15.8 to 19.4), and the weight of both thyroids averaged 6.5 milligrams. Thus a minimum effective dose of



THYROID GLANDS OF OREGON JUNCOS

FIGURE 1. Control, showing normal thyroid cells and follicles. × 270.

FIGURE 2. 43 days after a single injection of 100 microcuries of iodine-131. Note that the interior of the gland (bottom) consists of large blood sinuses and whorls of new connective tissue and that several nests of healthy thyroid cells can be seen just under the capsule (top). × 270.

FIGURE 3. 100 days after a single injection of 200 microcuries of iodine-131, showing complete destruction of the thyroid gland (right) and undamaged parathyroid (left). × 291.

200 microcuries is equivalent to 12 microcuries per gram of body weight or about 30 microcuries per milligram of thyroid weight. When estimating the minimum dosage for other birds (or other vertebrates), it is probably more satisfactory to use thyroid weight instead of body weight since the iodine is not diluted equally throughout the body but is concentrated in the thyroid cells. Rough calculations for the rat (based on Goldberg *et al.*, *op. cit.*) indicate that the mini-

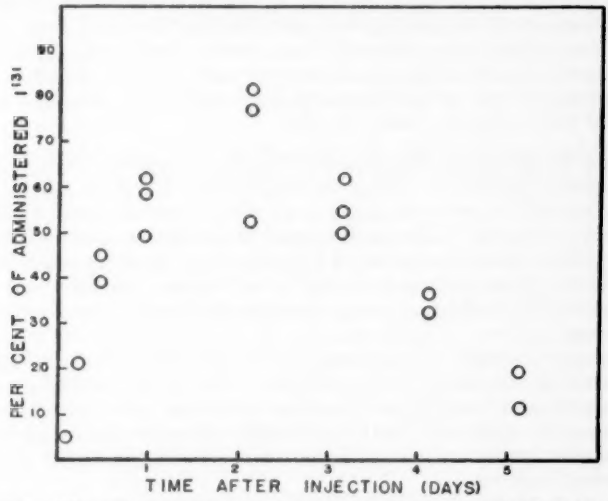


FIGURE 4. The per cent uptake and retention of a single injection of 4.3 microcuries of carrier-free iodine-131 by the thyroid gland of the Oregon Junco.

mum effective dose for this animal is about 35 microcuries per milligram of thyroid tissue, a figure very near that obtained for the Oregon Junco.

The uptake and retention curve in Oregon Juncos of a small dose of iodine-131 is similar to that obtained by Goldberg *et al.* for the rat. The peak of iodine-131 content in the thyroids of Oregon Juncos occurred 48 hours after the single injection, at which time they had accumulated about 80 per cent of the amount administered. The peak for the rat, 60 per cent of the amount administered, occurred 24 hours after the injection; but since no measurements were made at the 48 hour interval, it is possible that more than 60 per cent was actually taken up and that the curve for the rat might be more similar to that of the Oregon Junco than it now appears.

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Division of Anatomy and Institute of Experimental Biology, University of California, Berkeley, California, September 12, 1952.

GENERAL NOTES

Green-throated Loon (*Gavia arctica viridigularis*) in Southeastern Alaska.—On a cruise among the islands of southeastern Alaska in the spring of 1948, I saw many loons in the waterways and watched carefully, hoping to find *G. a. viridigularis* which had not been recorded in the area. When in Chatham Strait, well off the west coast of Admiralty Island, near Wilson's Cove, many loons were noted upon the glassy waters, and a Green-throated was collected on May 13. It was a male (DMNH no. 25415) with well developed testes, apparently going into its first high plumage. This form is similar in color to *pacifica*, but differs in having a uniformly dark crown and hind neck and in being approximately the size of *Gavia i. elasson*. The specimen collected has a tarsus of 80 mm., 10 to 14 millimeters longer than the tarsi of any of the 22 skins of *pacifica* in our collection. The middle toe is 111 mm. long as against 99 mm. for the longest *pacifica*.—ALFRED M. BAILEY, *The Denver Museum of Natural History, Denver, Colorado.*

Homing of the Manx Shearwater.—Shearwaters are ideal species for long-range homing experiments. During the long incubation period, one parent may remain in the nest for as long as twelve days; the birds are therefore accustomed to long periods of fasting. Many experiments with the Manx Shearwater (*Puffinus puffinus puffinus*) have been conducted from Skokholm, an island off the southwest coast of Wales. This island, made famous by the residence and works of the English ornithologist R. M. Lockley, is now a research station operated by the West Wales Field Society.

In the most remarkable of the prewar tests Lockley took two Manx Shearwaters by aircraft to Venice where he released them. Birds of this subspecies never normally visit the Mediterranean and do not cross dry land in their migrations. Yet upon release, one of the birds turned and headed west in the direction of the Italian Alps instead of flying south toward the sea. It reached its own burrow in Skokholm in 341 hours 10 minutes.

Dr. G. V. T. Matthews of the Department of Zoology, University of Cambridge, has been conducting further homing experiments with Manx Shearwaters. He has had birds released at many points on the British mainland and has enjoyed a startling series of returns. In many cases there was strong evidence of an initial sense of homeward orientation, because the birds started on a direct compass bearing for Skokholm. Attempts at sending birds to America had failed because the long journey by steamer exhausted them.

During a conversation with Mr. Lockley at Skokholm on June 1, I happened to say something concerning my anticipated return by air to Boston on the morning of June 3. Lockley at once realized the opportunity for quick transport and asked me to take two birds to Boston for release. Accordingly, I was given a carton containing two Manx Shearwaters which Dr. Matthews had taken from their burrows and banded. I left Tenby, Pembrokeshire, that evening via sleeper train for London. The birds caused no little wonder and merriment to the people in the adjoining rooms, who could not understand the origin of the mewing and cackling sounds which came from my room in the late evening. The next day the birds remained in the carton, each in its own compartment, and in the evening I enplaned for America with the birds under my seat. Only one survived the journey.

On the morning of June 3, immediately after landing and passing through Customs, I was driven in a TWA truck to the easternmost point of Logan International Airport on Boston harbor. There, with the kind cooperation of a TWA employee, I released

Shearwater AX6587 at the edge of the water, 100 yards from the point and on the southern shore of a tiny peninsula. It flew directly over the water to the end of the peninsula and then abruptly turned eastward over the ocean. This was at 8:15 a. m., E. D. S. T. June 3, 1952.

On June 20 I was surprised to receive the following cable: "MAZZEO, SYMPHONY HALL, BOSTON, MASS. No. AX6587 back 0130 BST 16th stop—FANTASTIC—MATTHEWS." A letter subsequently received said that Matthews on making his second round of the night of June 15/16, was "completely flabbergasted" to find AX6587 in its own burrow. He continued, "I read the ring several times, and then put the bird back and blocked the entrance. I wanted to make sure it would still be in when I took Peter Conder along to verify my observation. As we had not then had your letter, I was convinced that you must have run into trouble with our customs and released the bird at London. The boat came over that morning with your letter—there was no gainsaying the result then! A pretty touch, the bird beating the mail!"

The bird travelled more than 3200 land miles in 12 days, 12 hours, and 31 minutes, or an average of 250 miles per day.—ROSARIO MAZZEO, *Symphony Hall, Boston, Massachusetts.*

Night Rafting of American Golden-eyes on the Mississippi River.—Numerous observers have reported regular daily movements of flocks of American Golden-eyes (*Bucephala clangula americana*) on their wintering grounds. Recently I have had opportunity to study some of these movements in detail. For the past 12 years I have lived on the west bank of the Mississippi River about five miles north of the city limits of Minneapolis. Small flocks of golden-eyes, which fed during the day in the open places in the river, would fly down river past my home in the evening and up river again early in the morning. After a little local investigating I found that a night raft existed not far from the center of Minneapolis. Occasional observations during subsequent winters indicated that this was a relatively permanent, well-established concentration.

It was located at the upstream end of a long, narrow island about midway between the Broadway and Plymouth Avenue bridges, where the river is about 300 yards wide. A large steam electrical plant of the Northern States Power Company occupies the east bank of the river 1⅝ miles upstream; and the water, heated in the process of cooling the huge generators, keeps the river channel at least partially open to a point below the raft site even in the coldest weather. Evidently this accounts for the regular use of this location by the ducks. During the winter of 1949–50 I made many observations of this raft in an effort to understand better the nature of this regular concentration.

During a normal evening the ducks began arriving at the raft site about an hour before sunset and would continue to arrive until nearly an hour after sundown (Fig. 1). (This graph indicates the percentage of the entire flock that came in during 10-minute intervals before and after sundown.) It was so dark when the last flocks arrived that they could be distinguished only with difficulty against the faint light in the western sky. As a rule the birds arrived in small flocks that could be actually counted or at least fairly accurately estimated after a portion of the flock had been counted. As the birds settled down after dark they rafted into a compact mass in midstream just above the upper end of the island. In the morning small flocks of birds could be distinguished in the semi-darkness leaving the raft and going both up and down stream to their feeding spots. Only a few birds remained in the raft in the morning after the light became strong enough to discern its position on the water. The maximum number of birds recorded in the raft was somewhat more than 600.

From coordinated observations by a number of volunteer observers it was found that birds comprising this raft came from as far up stream as Elk River, nearly 27 miles, and from as far down stream as Fort Snelling, about 10 miles. Another similar raft was established in St. Paul and a third one on the St. Croix River a short distance above its confluence with the Mississippi.

The raft concentration came into being suddenly with the freeze-up in early winter. Figure 2 shows the total numbers of birds checked on 18 different evenings from December 9 to April 2. The river was open until early in December, when a cold

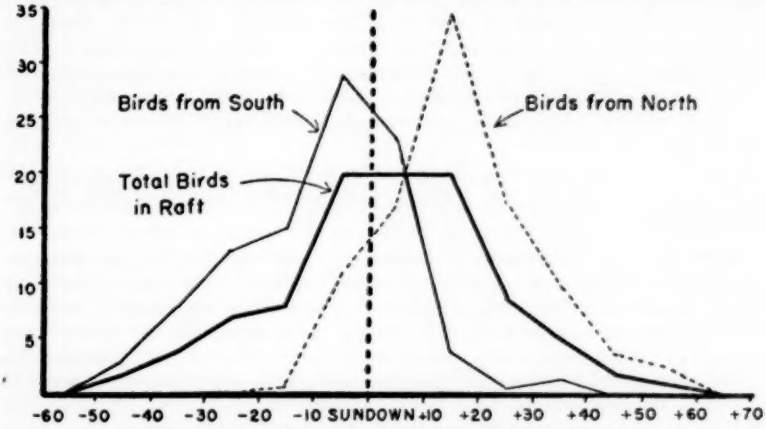

FIGURE 1. Arrival time of birds at night rafting site.

snap about December 8 suddenly froze over all the quieter portions of the river. Then, and not until then, did the birds begin the night concentration; and once it began, the maximum numbers started assembling there almost immediately. In spring the termination was almost as abrupt. This was brought about by warm weather and rain, causing the final break-up of the river ice on April 4.

It will be noticed (Fig. 2) that the numbers of birds making up the raft remained about the same until early February, when they dropped suddenly to almost half, then built back up to nearly the early winter maximum before the raft broke up in spring. Wide areas of comparatively rapid waters in the Mississippi River remained open well into January. It was not until a couple of weeks after the long continued cold spell of late January and early February (Fig. 2) that many of these areas finally became completely frozen over. Apparently this loss of feeding waters forced some of the ducks to move down river to adequate open feeding places. As soon as warmer weather in late February and March allowed some of these frozen feeding areas to reopen, the birds moved back to their former feeding locations before going on north to their breeding grounds. It will be noted that the later winter totals were only slightly below early winter counts. The same was the case during the previous winter. These slight differences might reflect some actual mortality, but no evidence supporting this was secured.

One interesting and still unexplained fact became evident as soon as the observations began. The majority of the birds coming to the raft from the south invariably came in earlier than did the birds from the north (Fig. 1). Here the average of 17 observations shows that the peaks in numbers of arriving birds from north and south

came about 20 minutes apart. A number of factors may be concerned with the arrival time of the birds at the raft. First, the birds that traveled farthest to this point came from the north, where the maximum distance was nearly three times as great as the maximum distance traveled by some birds from downstream. This could account for the very last birds to arrive at the raft always coming from the north, but does not adequately explain the fact that the earliest birds at the roost were invariably from the south. Another factor involved concerned the nature of the Mississippi River channel. Only a mile and a quarter below the raft site the

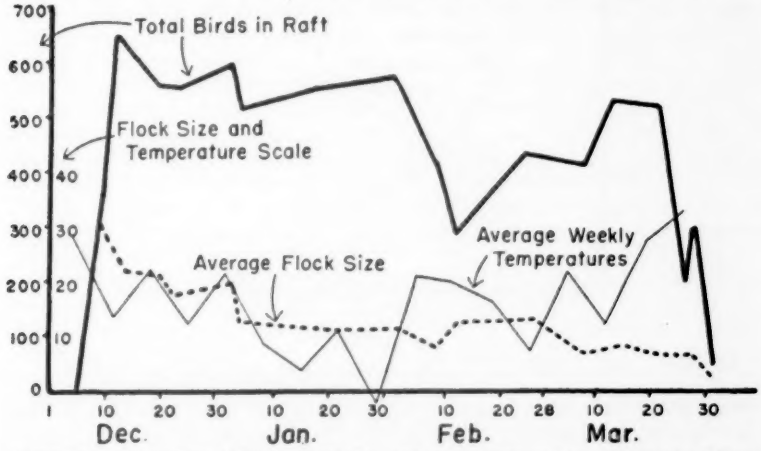

FIGURE 2. Numbers of birds, flock size, and temperatures throughout the winter, 1949–1950.

river drops over St. Anthony Falls. Below the falls the river is in a relatively narrow channel about 75 feet lower than the river surface above the falls. Naturally the light in late afternoon fails in the north-south portions of the gorge somewhat earlier than in the shallower channel above the falls. Numerous simultaneous light readings were taken at the raft site and at points below the falls where the evening shading effect of the west bluff was only moderate, and an average of only a few minutes lag was found between light readings of identical intensities. This was hardly enough to account for a 20-minute difference in the birds' arrival time at the raft.

Since failing light would seem to stimulate the birds' travel to the raft area, one would anticipate that the birds would arrive markedly earlier on cloudy days than on clear days. Strangely enough, this did not prove to be the case. In comparing light readings taken on cloudy and clear days (Fig. 3), one finds that the high intensities before sundown on clear days plunge rapidly after sundown while the lower intensities of cloudy days drop much more gradually until about a half-hour after sundown the readings become almost the same for clear and cloudy days. It thus seems evident from my limited observations that the movements to the raft by the majority of the American Golden-eyes are initiated by the light variations at low intensities at and soon after sunset and that the rapidly changing higher light intensities before sunset have no effect on their movements.

The average size of the flocks (Fig. 2, *dotted line*) coming in to the raft throughout the winter's observations shows that the birds have a definite tendency to be less

gregarious with the approaching mating season. This average flock-size dropped from 32 to 2.7 throughout the course of the winter. However, a definite drop occurred early in the winter, and the average did not drop toward spring as gradually as one might expect it to do. In this connection it was noted that active "courting" occurred throughout the period of observation, with little increase being observed in March over that seen in December. This suggests that perhaps these antics should be considered more as social behavior than as courting. Unfortunately,

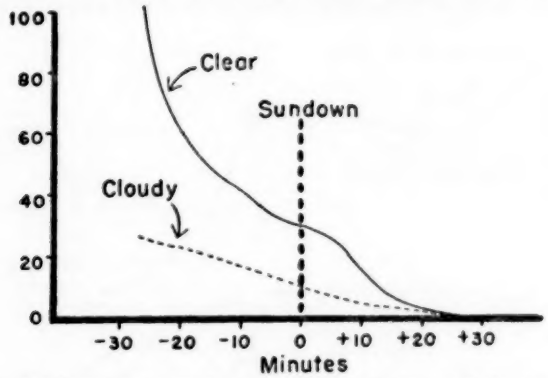

FIGURE 3. Light intensity readings at raft site on clear and cloudy days.

little could be recorded as to sex ratios in this study, since the majority of the birds came in after it was too dark to distinguish sexes. However, of those checked early in the winter, there were between seven and eight adult males to one female or immature.

The author appreciates the field assistance in this study rendered by the following: Harvey Gunderson, Bruce Hayward, John Jarosz, R. A. Kortmann, Warren Nord, Brother Pius, A. C. Rosenwinkel, Mr. and Mrs. Morris Self, and J. Donald Smith.—WALTER J. BRECKENRIDGE, *Museum of Natural History, University of Minnesota, Minneapolis, Minnesota.*

Notes on the Greater Sandhill Crane (*Grus canadensis tabida*).—*Feeding on acorns.*—On March 28, 1948, Harold Wing, Clarence Owens, Robert Whiting, and I observed a group of about 45 Sandhill Cranes feeding in a wood-lot on the Jasper-Pulaski State Game Preserve in Pulaski County, Indiana. The woods consisted almost entirely of white oak (*Quercus alba*) 30 to 75 feet in height and one to two and a half feet in diameter. The trees extended from the roosting marsh of the cranes up a gradually sloping hill. Apparently the cranes had gone into the woods from the marsh. Surprised at our sudden appearance, they took to the air. Until they had cleared the woods their wings often struck branches of the surrounding trees. Apparently they were feeding on acorns in the woods. Arthur E. Staebler at the W. K. Kellogg Bird Sanctuary, Augusta, Michigan, reported that a captive crane fed on acorns during 1951 when it was allowed to roam about the grounds.

Flying with retracted legs during cold weather.—On November 4, 1951, Robert Cornell and I watched 405 cranes come from the roosting area at Jasper-Pulaski Game Preserve in the early morning. The terrific snow storm of the previous night had covered the feeding area, a field of uncut corn, with several inches of snow. The

temperature at 6 a. m. was 17° F. The high temperature for the area on November 4 was 25° F. and the low, 10°. On November 3 the temperature had reached 7°. The highest mean temperature there for the first week of November was for the first, 33°, the next highest, 31° on November 7. Where the cranes roosted, we were not sure, but as they came over the woods into the corn field they carried the legs drawn in under the body, not trailing as is usually the case. All but four or five flew with the feet tucked into the feathers of the belly region. Once, I watched one crane, which was flying with feet stretched out behind, draw them in and fold them underneath, tucking them into the feathers. When they prepared to land they dropped their legs in the usual manner, but during their circling flight preparing to land in the field, they flew with feet drawn in. Their tails were much more conspicuous while flying when the feet were drawn in and were apparently spread more than usual. During the morning when the cranes rose periodically from the corn field to circle the area, they immediately tucked their feet into the lower feathers. From time to time, groups of two, three, and up to twelve cranes wheeled off to the south. Whether they were leaving for their southward flight we did not know, but a letter from Cecil H. Rowe, manager of the area, reported that 593 cranes were counted there on November 11, indicating that the low temperature of the previous week had not produced an early migration.

Copulation.—In the Mud Lake marsh, Leoni Township, Jackson County, Michigan, Dr. and Mrs. Powell Cottrille, Ken Bunting, and I were observing birds with a 20-power spotting scope on March 18, 1951. At 6:30 a. m. we observed two Sandhill Cranes along the west side of the marsh, standing beside each other. Suddenly one gave a jump, followed immediately by the other. One then stood still and the second hopped with outspread wings onto her back. She stood, without crouching, perfectly still as he settled down onto her and with his wings vibrating slowly he copulated with her. Apparently the wing motion was merely to aid his balance. He was on her less than a minute, then hopped off, and both stood preening for some time a few feet from each other.

In some notes from the Michigan Conservation Department sent to me by C. T. Black, Marvin Cooley observed copulation by a pair of Sandhill Cranes at the Rose Lake Wildlife Experiment Station area on March 25, 1942.—LAWRENCE H. WALKINSHAW, *1703 Wolverine Tower, Battle Creek, Michigan.*

Terns Recorded at Lake Texoma, Oklahoma, in Summer of 1951.—From June 7 to August 7, 1951, my ornithology class and I recorded terns of four species at Lake Texoma, on the Oklahoma-Texas border. Our base was the University of Oklahoma Biological Station along the lake's north shore, in Marshall County, Oklahoma. As a result of heavy rains the lake was exceptionally high in June.

From June 9 to July 29 we saw a few Least Terns (*Sterna albifrons*) almost daily, but we found no breeding colony. On June 15, Kenneth J. Starks and I each collected an adult. Starks's specimen, probably a female, weighed 38.8 grams. My specimen, a male with much enlarged testes, weighed 43.7 grams. We did not see any young birds before July 24. On that date, and again on July 29, we saw two or three young birds at the so-called "Engineers' Tract," a mile or so southwest of the village of Fobb. I believe that most Least Tern colonies were flooded out in June and that very few young birds were reared anywhere in the area.

We recorded a few Black Terns (*Chlidonias niger*) between June 15 and July 24. Not one of these was, so far as we could ascertain, in full breeding plumage, nor was one of them obviously a young bird of the year. Two specimens collected by Starks on June 20, and a bird found dead by William H. Adams, Jr., on July 1, were adults

in mixed plumage. Several birds which we saw at the Engineers' Tract on July 24 seemed to be in almost complete breeding plumage.

The Caspian Tern (*Hydroprogne caspia*) we recorded only once. On the morning of July 11, Mrs. John Whitaker and I saw three adults on a mud-bar about a mile west of the Station. We could not get very close, but identified the birds wholly to our satisfaction. The pileum of each was solid black. Mrs. Nice (The Birds of Oklahoma, rev. ed., 1931: 98) calls the Caspian Tern a "rare transient." She mentions a specimen taken August 19, 1925, near Okarche, in Canadian County.

On the evening of July 24, as a storm from the west was blowing up, Carl D. Riggs, Director of the Station, collected an adult male Forster's Tern (*Sterna forsteri*) about half a mile west of the Station. It was by itself. It weighed 176.2 grams, being quite fat, and was in excellent plumage. There was a scattering of white in the black of the pileum. The bill was dull orange throughout the basal half, dusky on the distal half. The feet and legs were bright orange-red, the eyelids dark gray and the eyes dark brown. The testes were very slightly enlarged (about 2.5 by 6.5). The tail measured 189 mm., each of the outermost rectrices being broken off at the very tip.

On July 31, I collected a young male Forster's Tern about a mile west of the Station. It was sitting on a stub in the middle of a large shallow arm of the lake. It weighed 154.8 grams and was quite fat. The bill was brownish black, the mouth lining dull orange-flesh color, the eyelids dark gray, and the eyes dark brown. The crown was white largely, though the occiput was flecked with dark gray and a large black spot enclosed each eye. The tail was much shorter than that of the male taken July 24, measuring only 134 mm. (The outer rectrices were in perfect condition.) The primaries were molting, the two outermost in each wing being old, frayed, and rather sharply blackish-brown and white, all the rest being new and silvery gray. The testes were very small (about 1.5 by 4 mm.). In both the adult and young bird the outer web of the outer rectrix was wholly white, the inner web being dusky toward the tip.

To the best of my knowledge the Forster's Tern has not been taken in Oklahoma before, though there must be unpublished sight records. The two above-discussed specimens (respectively, GMS Nos. 11157 and 11169) are, for the time being, in my own collection.—GEORGE MIKSCH SUTTON, *University of Oklahoma, Norman, Oklahoma.*

Ancient Murrelet (*Synthliboramphus antiquus*) Taken in Erie County, Ohio.—On March 28, 1951, Mr. Herb Nielson, a commercial fisherman, and his associates were fishing with a drag seine near Bay Bridge on Sandusky Bay, Erie County, Ohio, when their attention was attracted to two rather small birds swimming near their seine. One of the birds suddenly swam over into the net and dived beneath the surface of the water. Upon examination of their net, they found the bird had become entangled in the mesh and drowned. Meanwhile, the other bird flew away and did not return. The specimen was sent to Mr. Kosak of Cleveland, Ohio, who mounted it. The incident was reported to the writer by Clifford Morrow, Erie County Game Protector. On May 8, 1951, the writer examined the mounted bird, which has since been deposited in the Ohio State Museum through the kindness of Mr. Neilson. The accompanying photograph of the specimen (plate 5) has been provided by Dr. Edward S. Thomas of that Museum.

The only previously known record for this species on Lake Erie appears to be that cited by Bent (Bull. U. S. Natl. Mus. 107: 141, 1919) from Canadian waters. The

(*Left*) **Handley: Ancient Murrelet from Erie County, Ohio.** (Ohio State Museum No. 8005.)

(*Right*) **Grimes: Black-throated Oriole at nest in Southwestern Cameron County, Texas.** From a $2\frac{1}{4} \times 2\frac{1}{4}''$ ektachrome by C. T. Gill.

present specimen is therefore believed to be the first record of the Ancient Murrelet in Ohio.—DELMAR HANDLEY, *Federal Aid Project 61-R, Ohio Division of Wildlife, Castalia, Ohio.*

Black-throated Oriole (*Icterus gularis*) Nesting in Texas.—On June 5, 1951, the writer and his son Samuel, Jr. found two nests of *Icterus gularis* in southwestern Cameron County, Texas. Both nests were in a thickly wooded tract of two or three acres in size, in an area otherwise extensively planted to cotton; the location was one half-mile north of the Rio Grande, near the village of Santa Maria. We were informed by C. T. Gill and L. Irby Davis, both authorities on the birdlife of southern Texas, that this appears to be the first observed nesting of *I. gularis* in Texas.

Both of the nests were suspended from the terminal twigs of drooping branches of the Texas ebony tree (*Pithecolobium flexicaule*). They were about 100 feet apart and near the center of the thicket. The first nest found was of dried and yellowed grasses and may have been constructed the previous year. It was about 25 feet above the ground and hung over a small clearing in the thicket. The other was about 20 feet up and also hung over a little clearing. The second nest was under construction when found and was made, outwardly at least, of green grass. In the tree with the old oriole nest were two occupied nests of the White-winged Dove (*Zenaida asiatica*) and one of the Derby Flycatcher (*Pitangus sulphuratus*). The dove nests contained eggs; the flycatcher's, young. The tree with the new nest of the oriole held also a nest of the Verdin (*Auriparus flaviceps*) and unidentified dove nests. Mr. Gill kept the new oriole nest under observation until the eggs hatched, and on July 7 made several photographs of the parent birds at the nest (see plate 5). He reports that, as well as he could determine, only one young was reared.—SAMUEL A. GRIMES, *4627 Peachtree Circle, Jacksonville, Florida.*

Eastern Mourning Dove in the Dominican Republic—A Correction.—In 'The Auk' (vol. 58 (2): 260–261, 1941) I recorded an Eastern Mourning Dove (*Zenaidura macroura carolinensis*) carrying Fish and Wildlife Service band No. A-441887 banded at Gulfport, Florida, on March 30, 1932, by Mrs. Daisie M. Morrison, and recovered at Santiago, Dominican Republic, about July 25, 1934. The original letter of advice from Senor Pedro Escobosa referred to the bird as "una gaviota," the Spanish name for gulls and terns. Since, however, Mrs. Morrison stated that "my record shows A-441887 a Mourning Dove" the identification of the bander was accepted as correct.

The recovery was reported also, at a later date, by Senor Francisco Hernandez, of Sanchez, Dominican Republic, who has been most helpful in other cases involving recovery of banded birds in that country. He insisted that the bird was actually a "gaviota" [gull] and upon further investigation it develops that Mrs. Morrison used bands No. A-441878 and A-441884 on Laughing Gulls (*Larus atricilla*) on April 3, 1932, and April 4, 1932, respectively. There is a very strong probability that the bird recovered at Santiago was actually the Laughing Gull that carried band A-441884 and that the error resulted from misreading a 4 for a 7. The status of the Eastern Mourning Dove as a bird of the Dominican Republic should be at least held in abeyance pending further confirmation. I am indebted to Mr. Allen J. Duvall of the U. S. Fish and Wildlife Service and to Dr. Abelardo Moreno of the University of Havana for bringing this matter to my attention.—FREDERICK C. LINCOLN, *U. S. Fish and Wildlife Service, Washington, D. C.*

Geographical Variation in the Blue-throated Hummingbird (*Lampornis clemenciae*).—In 1918 Oberholser (Condor, 20: 181–182) described a northern race of the Blue-throated Hummingbird under the name *Cyanolaemus* [= *Lampornis*]

clemenciae bessophilus, specifying the Chiricahua Mountains of Arizona as type locality. He assigned specimens from New Mexico and even west Texas (Chisos Mountains) to this subspecies, describing the Texas specimens as showing "a tendency toward" *L. c. clemenciae* but as "decidedly referable to" *bessophilus*. (He included no Texas specimens among the 10 males and 2 females whose measurements he tabulated.)

In 1929, James L. Peters and I (Van Tyne, Auk, 46: 205) identified 6 newly-collected adult males from the Chisos Mountains as *L. c. clemenciae* rather than *bessophilus*, and this area was included in the range of *L. c. clemenciae* in the fourth edition of the A.O.U. Check-List (1931) and in Peters' "Check-list of Birds of the World" (Vol. 5, 1945). But in 1942, W. E. Clyde Todd (Annals Carnegie Museum, 29: 334) reported disagreement: "Three adult males from these mountains [the Chisos] are to my eye indistinguishable from Arizona birds."

Since I felt a certain responsibility, because of my 1929 report, for clearing up this problem, I recently re-examined the case. Thanks to the Max M. Peet Collection (University of Michigan) and to generous loans of specimens from E. R. Blake of Chicago Natural History Museum, James L. Peters of the Museum of Comparative Zoology, W. E. Clyde Todd of the Carnegie Museum, and George M. Sutton, I was able to assemble a much larger series than had been previously available. Most importantly, this assemblage included an adequate series of the southern form (*L. c. clemenciae*), unmixed with any possible wintering individuals from farther north. After eliminating unduly worn and damaged specimens, I had 17 adult males and 8 adult females of *L. c. clemenciae* (from the states of México, Michoacán, San Luis Potosí, Nuevo León, and Durango). Of *L. c. bessophilus* from Arizona I had 37 adult males and 25 adult females, all in good plumage.

A careful study of this series led me to a definition of *bessophilus* somewhat different from that given by the original describer: "Similar to *Cyanolaemus clemenciae clemenciae*, but bill shorter; male with upper parts duller, particularly on the rump, which is more washed with grayish; lower surface decidedly paler; and throat duller. Female duller above and paler below than the female of *Cyanolaemus clemenciae clemenciae*" (Oberholser, *op. cit.*, p. 181).

I found the bill in this species quite variable in length, even in adults, but the range of variation in *L. c. bessophilus* seemed to be precisely the same as in *L. c. clemenciae*. (The bill in *bessophilus* did appear to be, on the average, the more slender, especially as viewed from the side.) Secondly, I could discover no geographical difference in throat coloration of males. Except for these two points, my findings agreed with Oberholser's description.

The two subspecies are best distinguished by the following characters: In *L. c. bessophilus* both sexes have the upper parts duller—that is, paler and more brownish—than in *L. c. clemenciae*, especially on the posterior part of the back and on the rump. The lower surface in *bessophilus* is more variable, but it averages paler, particularly in the female. Further, the chin and throat are browner in the female of *bessophilus*, and, in fact, the females of the two subspecies are more readily distinguished than the males.

In addition to the two series from Mexico and Arizona on which I established the above distinctions, I had assembled 14 adult specimens (10 males and 4 females) from the Chisos Mountains, including the 3 adult males which Todd (1942: 334) assigned to *bessophilus*. I found on comparison that all 14 specimens clearly belonged with the series of *Lampornis c. clemenciae*. I believe, therefore, that the statements of the ranges of the two forms of the Blue-throated Hummingbird are

correct as they now stand in the 1931 A.O.U. Check-List and in Peters' "Check-list of Birds of the World."—JOSSELYN VAN TYNE, *University of Michigan Museum of Zoology, Ann Arbor.*

Forehead Color of the Pileated Woodpecker (*Dryocopus pileatus*).—Once an error has appeared in a description of a bird or a particular plumage of a bird, it tends to be repeated in succeeding publications. A writer well informed about a particular species may have corrected the error in his own publication, and students looking for detailed information about a species are often bewildered by these apparent contradictions. Such a situation prevails in the published descriptions of the forehead color of Pileated Woodpeckers.

Among woodpeckers in general, several situations are to be found as regards the resemblance of juveniles to adults. In many genera, the young resemble the male more than they do the female; or at least, both sexes of the young have the bright markings, red or yellow, of the male parent, though not always in the same location. Young Red-headed Woodpeckers differ from their parents in the color of the entire head. The situation in the Pileated Woodpecker seems to be unique in the family. Not only can juvenile Pileateds be recognized as to sex by their forehead and moustache color, but this difference is apparent as early as nine or ten days after hatching, when the color of the developing feathers can be seen through the skin. Even before the eyes have opened, it is possible to recognize the red forehead and moustache of the male, the dark forehead and black moustache of the female. Juvenile male Pileateds do *not* resemble the female parent, in spite of numerous published descriptions stating that they do. This point was made by my late husband (Auk, 61: 380, 1944), but the error is still being made in print.

There is another point in regard to the forehead color of Pileated Woodpeckers which needs clarification—the actual color of the forehead in juvenile and adult females. For while the juvenile female resembles the adult female in general appearance as stated above, the color of the forehead undergoes a distinct change in the post-juvenal molt and continues to change somewhat with succeeding post-nuptial molts. It is this fact, apparently, which has led to some of the conflicting descriptions in literature. Let us examine several of these descriptions:

Ridgway (U. S. Natl. Mus. Bull., 50: 156, 1914) describes the adult female thus: "Forehead and anterior half (more or less) of crown grayish brown or olive." Of the young female he says (p. 158): "Forehead and most of crown grayish brown, the latter with a paler terminal spot on each feather."

A. C. Bent's description of the young female (U. S. Natl. Mus. Bull., 174: 168, 1939) is similar: "the forehead and most of the crown are grayish brown, which invades the red posterior portion of the crown."

However, E. H. Eaton (N. Y. State Mus. Mem., 12: 152, 1914) says: "Female and young have only the rear portion of the head red, the frontlet and the moustaches being blackish." I point out in passing that this is in error in regard to the young male.

T. S. Roberts ('Birds of Minnesota,' Minneapolis, Univ. Minn. Press, 1932: 620) agrees with this, at least as to the description of the female. In his key to woodpeckers, he lists the Pileated Woodpecker female as having "Anterior half of crown black or blackish."

W. E. Clyde Todd ('Birds of Western Pennsylvania,' Pittsburgh, Univ. Pittsburgh Press, 1940: 321) describes the female as having the top of the head scarlet, "with the forepart brown."

E. H. Forbush ('Birds of Massachusetts and Other New England States,' Massachusetts Dept. Agric., 1927, pt. 2: 281) describes the adult female as similar to male, but "whole forehead and forepart of crown olive-brown or grayish brown." And "Young female similar to young male, but forehead and forepart of crown and jaw more like those of adult female; forecrown with paler edging at end of each feather."

Just in these few examples we have found the forehead of the adult female described as black, blackish, brown, olive-brown, and grayish-brown. The forehead of the juvenile female has been similarly described, and by some writers the young are said to be identical with the adult female, by others slightly different.

My husband and I took particular notice of this point in our observations of female woodpeckers, and I believe that the following is the true situation. Some of our observations were on a bird raised in captivity.

The juvenile female Pileated Woodpecker, in the nest and for several months after leaving the nest, has a very dark gray or blackish forehead. The individual blackish feathers are uniform throughout and the paler edging described by some is hardly perceptible. These feathers do invade the anterior portion of the red crown, and most of the red feathers are red only at the tips.

With the post-juvenal molt of the head, which occurs in September, these blackish feathers are replaced by grayish-brown feathers which do have a noticeably paler edging, and with succeeding post-nuptial molts the forehead becomes more olive-brown and eventually yellowish-brown. In our captive bird, the yellowish color was pronounced when she was six years old, and changed little after that.

It is suggested that careful observations be made on specimens taken in the future and notes made of forehead color, so that if this color distinction is valid, it may be incorporated in future descriptions.—Sarah F. Hoyt (Mrs. Southgate Y. Hoyt), *"Aviana," Box 54, Etna, New York.*

Notes on Two Rare Tyrannids of Mexico.—*Aechmolophus mexicanus* Zimmer heretofore has been known from only three specimens: the type, an adult male in the American Museum of Natural History, taken at "Cuernavaca, Mexico" at an altitude of 5000 ft. April 9, 1908, by Austin Paul Smith; a second specimen in the United States National Museum, taken at the same locality on the same day; and the third, a specimen in the Museum of Vertebrate Zoology, secured at Chilpancingo, Guerrero, October 26, 1940. I acquired a special interest in this extraordinary genus, because I had the second specimen in my hands, noting its conspicuous crest, when Dr. Zimmer came into the room at the United States National Museum and identified it as the second known individual. It seemed likely that the continuous collecting by Chester C. Lamb, always alert for new forms, would eventually discover other individuals. He did and noted the crest in his field journals, designating his birds as the "Crested Long-tailed *Empidonax*." Then several months ago, my assistant, Dr. John Davis, while engaged in the long process of transferring to the main collection the specimens which had come from Mr. Lamb during the war years, brought to me eight individuals, which he suspected to be and I identified as *Aechmolophus*. This was confirmed by Dr. Zimmer, to whom I mailed an adult February specimen from Tequisistlán, Oaxaca. He wrote: "Aside from the fact that your bird is in fresher condition with the light colors clearer (yellower on the under parts and more tinged with buff on the wings) and with the olive margins of the crest feathers less worn and hence slightly reducing the acuteness of these plumes, there are no appreciable differences in plumage."

These eight hitherto unreported specimens were all secured at two localities in Oaxaca on five different dates between July 4, 1943, and February 18, 1947. The

six July birds represent a breeding colony and include a fledgling just out of the nest. Subsequently, other specimens were taken at Rancho Papayo, Puebla. Finally, between July 21 and 26, 1951, when encamped near Titzio, Michoacán, about 18 mi. E. by S. E. of Morelia, Dr. John Davis and Chester Lamb secured two adult males, two immatures, and one fledgling, undoubtedly representing another breeding colony. Therefore this species is now known to occur in five different states: Michoacán, Morelos, Puebla, Oaxaca, and Guerrero, which gives us a better conception of its range. It should be noted that the original description refers to the type locality as "Cuernavaca, Mexico." This is undoubtedly Cuernavaca in the state of Morelos and not the state of México.

The Moore Collection series of fifteen specimens gives us our initial knowledge of the breeding range, which extends at least from eastern Michoacán southwest through Morelos and southwestern Puebla to northwestern Oaxaca. In winter, at least, it ranges south to central Guerrero (Chilpancingo) and may breed there. No specimens from the center of this range, the State of México, have been discovered so far, but it seems reasonable to expect they will be found in old collections, probably in series of Empidonaces. Our specimens have been collected between about 4000 and 6000 ft. altitude. It is probably a much more common species than the eighteen known specimens indicate. Dr. Davis reports that it is a very quiet bird (neither he nor Chester Lamb heard it call) and that it is impossible to distinguish it in the field from several forms of the genus *Empidonax*.

Xenotriccus callizonus Dwight and Griscom is known from five specimens, three from the type locality, Panajachel, Lake Atitlan, Guatemala, and two collected by Pierce Brodkorb at Chichimá, Chiapas, México in 1941. During the previous year, on June 23 and July 14, 1940, Mario del Toro Avilés secured for me a male and a female at Ocozocuautla, Chiapas, but this is the first time they have been reported. This makes a total of four individuals taken in México, all from the State of Chiapas. —Robert T. Moore, *Laboratory of Zoology, Occidental College, Los Angeles.*

Food Habits of the Bobolink in Arkansas Rice Fields.—Prior to recent observations by the writers in the Arkansas rice fields, the Bobolink (*Dolichonyx oryzivorus*) was unreported as a fall migrant in the state of Arkansas. Several small flocks averaging about a dozen birds were first noted feeding in rice fields near Stuttgart on September 1, 1950, and during that autumn and the following, Bobolinks were seen almost daily, with the latest observation on October 24, 1951. In 1951 the earliest record was August 16. While the date of the seasonal population peak is controlled largely by weather conditions to the northward, the peak for the two seasons, 1950–1951, was approximately September 15. On that date in 1951, 435 Bobolinks were counted in one rice field, and a portion of this number, sometimes numbering as many as 100, remained in the same field for 25 days.

During the spring flight Bobolinks in this area are found primarily in oat fields, occasionally in newly sown rice fields, and often in grass fields. Although Bobolinks may be seen in rice fields any day throughout September, the few individuals involved inflict little damage to the crop. From field observations it is obvious that during their stay in Arkansas rice districts, they feed largely upon oats in the spring and rice in the autumn. However, since the writers were engaged in a study of depredations to farm crops in the area by other species, it seemed desirable to obtain specific information on the food of the Bobolink. During September and early October, 1951, in the vicinity of Stuttgart, 30 Bobolinks were collected and the stomach contents analyzed. The following table lists the data obtained.

STOMACH CONTENTS OF 30 BOBOLINKS, NEAR STUTTGART, ARKANSAS, SEPTEMBER AND OCTOBER, 1951

Food item	*No. stomachs*	*Per cent occurrence*	*Per cent by volume*
VEGETABLE			
Rice, *Oryza sativa*	30	100.0	76.0
Paspalum sp.	19	63.3	14.3
Echinochloa colonum	10	33.3	2.9
Panicum sp.	5	16.7	2.4
Setaria lutescens	2	6.7	1.2
Ambrosia sp.	6	20.0	0.5
Polygonum sp.	1	3.3	0.1
Brachiaria extensa	2	6.7	T
INSECT			
Coleoptera sp.	1	3.3	2.7
Rhynchophora sp.	1	3.3	T
Homoptera sp.	4	13.3	T
Pentatomidae sp.	1	3.3	T
Locustidae sp.	6	20.0	T

BROOKE MEANLEY, *U. S. Fish and Wildlife Service, Stuttgart, Arkansas,* and JOHNSON A. NEFF, *U. S. Fish and Wildlife Service, Denver, Colorado.*

Breeding of the Purple Finch (*Carpodacus purpureus*) in the Pocono Region of Pennsylvania.—Purple Finches have been much in evidence during the past three breeding seasons on the Pocono Plateau in Monroe County, Pennsylvania; and from the information I have received they are apparently regularly common summer residents in this part of the state. During the spring and early summer of 1951, three or four fully adult males were seen quite constantly about our home in Pocono Lake, and the songs of these birds were heard all day long.

One day in mid-May my wife called my attention to a female which was engaged in collecting dog hairs from the cracks between the floor boards of the back porch. Her mate was sitting a few feet away, displaying in the manner so characteristic of the species, but she seemed to be utterly oblivious of his presence. The dog hairs, each about one to one and one half inches in length, were picked up one at a time and held crosswise in her bill. After she had gathered quite a mouthful—and appeared to have a ludicrous mustache—she departed, followed by the male.

On the evening of June 25, I heard the incessant calling of young birds in a blue spruce tree in front of the house; and I located a nest with 4 well-fledged young about 20 feet from the ground, near the top of the tree. The following morning they had all left the nest and were heard calling from points up to 50 feet away. The call notes were characteristic—entirely unlike those of any other young birds; a loud and emphatic, two-syllabled *cher-wee*. This note was given repeatedly with very brief intermissions. For about a week thereafter we heard it constantly from the trees in the vicinity of the house.

On the morning of June 26 a female was observed carrying nesting material to the top of an adjoining blue spruce. Some Cedar Waxwings were building in a nearby red maple, and I had been watching them make attempts to get nesting material from the frayed ends of a clothesline. I placed some tow in the crotch of a tree, and this they most readily accepted. The female Purple Finch likewise discovered the tow and utilized it in her nest building. I was away from home for about ten days in the early part of July, and during this time the young apparently left this nest. On the morning of August 9, I heard the characteristic *cher-wee* of a young Purple Finch and discovered the mother feeding it on the electric line in front of the house. The latter bird evidently had not been out of the nest more than a week.—WILLIAM C. GRIMM, *Pocono Lake, Pennsylvania.*

The Original Description of *Hesperiphona vespertina montana* Ridgway.—"*Hesperiphona vespertina*, var. *montana*" has been universally credited to Ridgway, *in* Baird, Brewer, and Ridgway, History of North American Birds, Land Birds, vol. 1, 1874, p. 449, pl. 22, fig. 4. Curiously, authors have ignored the adequate description previously given by Ridgway under the same name in the Bulletin of the Essex Institute, vol. 5, November, 1873, p. 189. Ridgway, himself (Bull. U. S. Natl. Mus., 50, pt. 1: 43, 1901) dismissed the 1873 usage of the name as a nomen nudum, which it certainly is not. Even were there no description here, a reference is given to "Birds of California" [= Baird, *in* Cooper, Ornithology of California, 1870], p. 175, where there is a description with a text-figure but without a distinctive name.

The question then arises as to the type locality for *montana* of 1873. On page 181 the name is used without discussion in a list of Colorado birds. On page 189, two specimens are recorded from Waukegan, Illinois, as belonging to "this southern race," but they are obviously secondary and not the basic specimens. The explanation lies in the 1870 book to which reference is made where the range of the distinct, but unnamed, southern population is given as "table-lands of Mexico, extending northward into New Mexico." There, also, occurs the text-figure of the new bird which was reproduced with the 1874 usage, being latterly identified as based on U. S. National Museum no. 35150 from Mexico. Still later, Grinnell (Condor, 19: 20, 1917) established the identity of the specimen in question as having been collected by Dr. C. Sartorius at Mirador, near Veracruz; original number 180. Justifiably, as claimed by Grinnell, this specimen should be considered as the type of *montana* of 1874, and with equal logic occupies the same position with reference to *montana* of 1873. Mearns (Auk, 7: 247, 1890) claimed as type, U. S. National Museum no. 11960, from Cantonment Burgwin, New Mexico, and other authors accepted his dictum until Grinnell (*loc. cit.*) objected on the ground that such subsequent selection did not invalidate the claim of no. 35150 to its original position as type. The fourth edition of the A. O. U. Check-List (1931) accepted Grinnell's thesis.

Recognition of the 1873 paper as the original source of the name *montana* entails little change other than that of bibliographic reference and date. The type and type locality remain as at present accepted for the name of 1874, but since the type locality is not specifically mentioned in the original account, it should be indicated that Mirador, near Veracruz, Mexico, was ascertained from other sources (Baird, 1870; Ridgway, 1874; and Grinnell, 1917).—JOHN T. ZIMMER, *American Museum of Natural History, New York.*

The Original Edition of Azara's 'Apuntamientos.'—A curious fact has recently come to hand concerning Azara's famous work on the birds of Paraguay and eastern Argentina. Having occasion to refer to one of the species supposedly discussed in volume 1, I was surprised to find that the copy of the work in the library of the American Museum of Natural History did not have the account of the species in question. Further investigation revealed that volume 1 ended on page 399 with the discussion of species 101; volume 2 began with the preliminary matter on species 145, leaving a hiatus of 44 species that were neither discussed nor listed in the index.

Volume 1 is, however, a complete entity. Page 399 ends in the middle with the inscription: "Fin del Tomo Primero de los Páxaros," and the bottom half of the page and the reverse of the leaf are blank. All signatures are complete, and page 399 is on the last leaf of its signature. The index to species 1 to 101 ends in the middle of a signature that is continued with other matter. Nothing is missing although the volume is obviously less extensive than it is supposed to be. The title is exactly as transcribed by Coues (Bull. U. S. Geol. Geog. Surv. Terr., 5 [no. 2]: 246, Sept. 6,

1879) with the addition of a blazon (which Coues omitted to mention) preceding the date line. In further distinction from Coues, there is an additional preliminary leaf with the half-title, forming part of the first signature which would be incomplete without it.

Volumes 2 and 3 have no half-titles; the title-page in volume 2 is not part of the first complete signature, but in volume 3 it is. The wording of the titles in these two volumes follows closely that of volume 1 with the exception of the date and imprint (and the omission of a period after the name of the author in volume 3). Both volumes are dated 1805, and the imprint of "Ibarra" is altered to "la hija de Ibarra" in volume 2 and "Doña Manuela Ibarra" in volume 3.

Dr. Herbert Friedmann of the U. S. National Museum kindly loaned me the copy of Azara's work in that institution, and I have compared it with the American Museum copy. Volumes 2 and 3 appear to be identical in both sets. Volume 1 is quite different. In the National Museum copy, the leaf with the half-title is missing. The original leaf containing page 399 with a half page of print and the notation regarding the end of volume 1 is also missing. In its place is a new leaf, the first of a new signature (not the last of the original signature) with the text of the old page 399 reprinted, apparently from the same type, but without the colophon, and continuing with the new matter relating to species 102 and its relatives. The text continues thereafter to page 534 and species 144. Furthermore, an extra leaf is inserted in Signature C of the introductory matter, bearing the duplicate page numbers XIII and XIV and containing the references to species 102 to 144.

These additions are all printed on paper which is quite unlike that of the rest of the volume, but like the paper used in volumes 2 and 3. The other pages are identical as to typography and paper with the corresponding parts of volume 1 in the American Museum copy. James L. Peters wrote me that the set in the library of the Museum of Comparative Zoölogy is similarly complete except that the index lacks the added pages referring to species 102–144.

I have a theory concerning the two formats of volume 1, but it is no more than that. The American Museum copy of volume 1 probably demonstrates the originally planned format which would have necessitated either more than two additional volumes or distinctly more bulky ones. Volume 1 was printed in the short format. Whether it was actually issued to the public in that format I am unable to say. The present copy may have been a private one. At any rate, about that time there appears to have been some change in the printing firm as evidenced by the imprints on the three volumes, and perhaps volume 1 was held in reserve until the work could continue. In 1805, volumes 2 and 3 were printed. Judging by the quality of the paper, I suspect that at the same time the additional parts of volume 1 were also printed and the copies of that volume on hand made up in the new standard. If the short volume 1 had been issued to the public, the new pages could have been made available to purchasers or subscribers with which to complete their copies, but the entire set of three volumes may actually have come out at the same time. I believe that pages 399 (part) to 534, and perhaps the whole volume, should be dated 1805, not 1802.

I can find no contemporary references to the book around either 1802 or 1805. If any can be found, they should supply the proof needed. In any case, the matter of date is only of academic interest. Azara used only Spanish vernacular names for his birds, and later authors, basing their accounts on his descriptions, supplied the scientific names whose dates are sometimes critical. Likewise I can find no indications of the existence of the short format of volume 1 in any of the bibliographic

references that I have consulted. It would be interesting to learn more about the publication of this historic work.—JOHN T. ZIMMER, *American Museum of Natural History, New York, N. Y.*

A Convenient Method of Confining Live Birds for Weighing.—Bird students interested in obtaining data on weights of live birds are often surprised at the scarcity of such information. This is particularly true of small song birds despite the fact that many of these are trapped and banded. Difficulty in holding birds still while weights are taken has, perhaps, accounted for the fact that weights are often not taken, even by active bird banders.

For keeping birds comparatively motionless while being weighed, thick-walled glass tubing, cut in six-inch sections and open at both ends, has proved very convenient. Birds are inserted into the tubing head first, and, after weights are taken, they may be easily shoved through and released. While confined within the tube, they cannot move wings or legs to any great extent, and there is small chance that they will be injured in the process.

A set of three glass tubes, of 1.0, 1.25, and 1.5 inch diameters, is sufficient to handle practically all small birds. Weights of the empty tubes may be scratched on with a diamond point. Tubes are easily carried in the slotted pockets of a jacket. Plastic tubes are, of course, lighter, but they collapse easily, and are more subject to breakage.

Small boxes have often been used for confining live birds during the weighing process. These are bulkier than glass tubes, and there are greater chances that birds will escape while being inserted into, or released from, a box. The method described above seems to obviate many of the difficulties which have prevented the collecting of weight data.—MAURICE BROOKS, *Division of Forestry, West Virginia University, Morgantown, West Virginia.*

Young Bluebird Taken from Nest-box by Sparrow Hawk (*Falco sparverius*).—On June 10, 1950, I noticed a female Sparrow Hawk on the top of a Bluebird nest-box located on a pole 100 feet from my residence. The hawk was eating a small bird which proved to be one of the three fledgling Bluebirds known to have been in the nest.

I secreted myself in a building 50 feet from the nest, and after a few minutes the hawk returned, landed on a projection below the box entrance, and tried, by extending its foot into the box, to extract another bird. This time the parent birds noticed the intruder and succeeded in driving it away. As soon as the old birds left the vicinity of the nest the little falcon returned, this time to be immediately attacked and driven away by a Kingbird. It did not return again that day, but an inspection of the box the following morning showed but one fledgling, indicating that the other one may have been taken in the early hours.

I then removed the perch that the hawk had used when reaching into the box, and without which I doubt if it could have secured its prey.

The remaining young bird was still in the box a week later.—HOWARD DRINKWATER, *Old Road, Whitehouse, New Jersey.*

NOTES AND NEWS

The Old World Cattle Egret (*Ardeola ibis*) has recently been recorded in several of the eastern states; we plan to publish the first North American specimen record in the next issue. This invasion appears to have come from northern South America where the species has been established for over twenty years. Here, we have an almost unrivaled opportunity to study the spread of a species on a new continent, a natural experiment which may provide answers to many questions. The more obvious ones are: How far will it go? How fast will it spread? Will it compete with the native birds? And what will be its food and habitat preferences in its new environment? Of even greater significance, however, are such biological questions as: Are clutch-size and nest-success greater when the species is rapidly expanding its range than when it reaches an equilibrium with its environment? What is the effect of the size of a colony on nest-success and on habits in general? And to what extent do these birds wander naturally, and how might this be connected with their remarkable spread?

Now is the time to lay the ground-work for an intensive study of these problems. We hope that a small group of energetic people will organize such a study soon. The job will not be easy: the project must be planned with great care, many groups should be circularized, and large amounts of data must be collected, evaluated, and synthesized. But the results should be of great importance.

The views of the editor on this project are not entirely altruistic. If, as we expect, this species will spread through a large section of North America, we will be deluged with notes describing its first occurrence in each region of each state to which it spreads, and we do not like turning down manuscripts. The publication of such isolated notes is, relatively speaking, of little significance. How much better it would be to utilize space in this journal for a comprehensive report. Certainly the ornithologists working fifty years from now will thank the organizers of a cooperative project which will accomplish this. We hope that we can announce the inception of such a project in an early issue of the Auk.—R. W. S.

Seventy-first Stated Meeting

The Seventy-first Stated Meeting will be hold in Los Angeles from Wednesday October 21 through Sunday October 25, 1953, at the invitation of the Los Angeles County Museum. Dr. Jean Delacour is Chairman of the Local Committee on Arrangements which includes the following other officers: Kenneth E. Stager, Secretary; C. V. Duff, Treasurer; J. R. Pemberton, Finance Chairman; Ed N. Harrison, Field Trip Chairman; and Vernon Barrett, Entertainment Chairman.

Attention is called to the fact that the meeting has been scheduled to begin on Wednesday and conclude on Sunday. This has been done to encourage attendance of members who cannot get away during the week. Under the present plan, business meetings will be held on Wednesday; papers sessions will occupy Thursday, Friday, and Saturday; the field trip will probably be scheduled for Sunday. If members can come for just the weekend they will be able to attend one day of papers sessions, the field trip, and the banquet (which should be on Saturday night if last year's plan is followed).

Members are urged to begin making their plans now not only for attending the meeting, but also for the presentation of papers and motion pictures. The deadline for receipt of papers has been too late in recent years to permit any careful planning of the program. We are planning to set the deadline earlier this year and also send out the announcements will ahead of the deadline. It is hoped that those who are

planning to attend the meeting and will be leaving for field work by the end of June will submit their papers before then, or advise the Secretary of their plans.—ALBERT WOLFSON.

STUDENT MEMBERSHIP AWARDS FOR 1953 SELECTED BY THE A.O.U. COMMITTEE ON STUDENT MEMBERSHIP AWARDS

Stuart Allen Altmann, University of California at Los Angeles
Joseph Thexton Armstrong, Jr., Carleton College, Northfield, Minnesota
Mary Edith Barraclough, Montana State University, Missoula
Marjorie Ann Briggs, University of Florida, Gainesville
Philip Serna Callahan, University of Arkansas, Fayetteville
Ronald L. Church, San Jose State College, California
Robert Verity Clem, Yale University, New Haven, Connecticut
Frances Rowe Crews, Louisiana State University, Baton Rouge
Norman Roger French, University of Utah, Salt Lake City
Alan George Gordon, University of New Brunswick, Fredericton
Lloyd Burrows Keith, University of Alberta, Edmonton
Eugene Allen LeFebvre, University of Minnesota, Minneapolis
Edward Palmer Lincoln, University of Arizona, Tucson
Raymond Lewis Linder, University of Nebraska, Lincoln
Eugene Albert Lyons, Brigham Young University, Provo, Utah
William Joseph Maher, University of Michigan, Ann Arbor
Aubrey Steven Messenger, North Carolina State College, Raleigh
James H. Oliver, Jr., Florida State University, Tallahassee
Edward B. Reed, Colorado A. and M. College, Fort Collins
David Caldow Townsend, Louisiana State University, Baton Rouge
Olof Charles Wallmo, A. and M. College of Texas, College Station
William Richardson Whitmore, University of Massachusetts, Amherst
Donald Dean Williams, University of Nebraska, Lincoln

The name of Phillips B. Street was inadvertently omitted from the list of members of the Union's 1952 Committee on the Nomination of Associates (Auk, 70: 94).

About 160 members and guests attended the 75th annual meeting and dinner of the Linnaean Society of New York on March 10, 1953. John Kieran was master of ceremonies. He introduced, in turn, Beecher Bowdish, Roger Tory Peterson, James P. Chapin, and Ludlow Griscom, all of whom spoke, in a reminiscent vein, of the Linnaean Society of yesterday and today. John Bull, Jr. was elected president of the Society for the ensuing year.

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RECENT LITERATURE

Natural History and Differentiation in the Yellow-bellied Sapsucker.—Thomas R. Howell. Condor, 54 (5): 237–282, 7 figs., 1952.—The four generally recognized subspecies of *Sphyrapicus varius* constitute a fascinating example of avian evolution. Their complex relarionships put to the test some of our modern criteria of species and subspecies. The ranges are almost wholly complementary: *S. v. varius* breeds across much of the northeastern United States and southern and western Canada; *S. v. nuchalis* is the bird of the Rocky Mountains, and ranges west to the Cascades; *S. v. daggetti* is confined principally to the Sierra Nevada, northern California, and adjacent areas; and *S. v. ruber* inhabits the Pacific Northwest. Most features of their life histories seem to be identical. Yet the migratory tendency is strongly developed in *S. v. varius*, progressively less so in *nuchalis* and *daggetti* respectively, and practically absent in *ruber*. Sexual dimorphism diminishes in a corresponding manner, disappearing altogether in *ruber*. The coloration varies so strikingly that the two western races, the "Red-breasted Sapsucker," have often been treated as a distinct species. More remarkable, in most of the limited areas where the breeding ranges of two races do come together, intermediates are far in the minority and interbreeding relatively uncommon. Only in the case of *daggetti* and *ruber* is a considerable zone of intergradation found.

The author undertook as his doctoral thesis the investigation of this intensely interesting situation, by combined laboratory and field studies, placing special emphasis upon the critical point of the "breeding behavior of the races at the points of junction." His findings are most interestingly summarized in this paper, along with his conclusions concerning the present status and possible history of the several forms.

Study of the pigmentation brings out the fact that the color differences, while probably genetic, are not as fundamental as they might first appear, the red carotenoid pigment being deposited chiefly at the tips of the feathers, and the red areas thus overlying to a large extent the black and white pattern beneath. But the characters are distinct enough to permit field recognition of the racial types and of intermediates, under favorable conditions even in juvenal plumage. The possibility of such recognition of living individuals enabled the author to make his greatest contribution: series of detailed nest observations in a number of selected areas of overlap.

When Howell's original data are combined with the published records, and inferences made from the numbers and types of intermediates in collections, there are still wide gaps in our knowledge; but the picture of the interbreeding now becomes much clearer. Apparently there is considerable interbreeding where *S. v. varius* meets *nuchalis* (though this remains obscure), and where *nuchalis* meets *daggetti;* very little is to be found, however, in the areas where *ruber* comes east into central British Columbia to meet and separate the ranges of *varius* and *nuchalis*. The situation the author describes in some of these areas of contact is such that almost within a stone's throw may be found nesting pairs of each of two races, mixed pairs, and intermediates actually mated and raising young. A few miles to either side the breeding population, save for stray individuals, is made up exclusively of one race or the other. With such field data presented, and appropriately backed up by specimens, there can be little argument about the virtual allopatry or about the interfertility of these forms. The studies brought to light no differences in breeding behavior, and certain small variations in habitat preference are not always operative. By the widely accepted criteria here used, it is clear that the four populations can only be

regarded as belonging to one polytypic species. But is it equally clear that only exceptionally could subspecies be expected to show such a degree of distinctness, or the dividing line between "intergradation" and "hybridization" would become tenuous indeed. During geographic isolation, this differentiation certainly proceeded far toward that point at which, with contacts re-established, full reproductive isolation would have been effective, and the specific level reached.

The author's discussion of the isolating mechanisms now in effect, and of the probable evolutionary history, appears well thought-out and sound. He invokes a combination of habitat preferences, ecological barriers, differences in migratory behavior, and differing sexual dimorphism, to explain how interbreeding is kept at its present low rate, and confined within its present narrow zones. Deriving *Sphyrapicus* from *Dendrocopos*, Howell further postulates that the species *S. varius* was broken into subspecies in the Pliocene, with further isolation during Pleistocene glaciation, and that present contacts, and the evolution of *S. v. ruber*, have come about since the retreat of the Wisconsin ice. While such hypotheses are difficult to evaluate, the suggestions appear very plausible, in so far as we are able to judge from the ecological data presented.

There are some three or four typographical errors in the text. A trivial fault, which annoyed this reviewer, is that most of the figures (the local sketch maps), very useful in visualizing situations, have been inadequately tied-in with the text; at least three do not even seem to be referred to, and some further use of correlating numbers or symbols might have increased the usefulness of all. Such defects, I should judge, must be in part the result of abridgement for publication, and detract but little from this very noteworthy contribution to the literature of bird speciation. —William A. Lunk.

Avian Systematics and Evolution in the Gulf of Guinea. The J. G. Correia Collection.—Dean Amadon. Bull. Amer. Mus. Nat. Hist., 100: 393–452, 4 pls., January 20, 1953. $1.00.—The islands of Fernando Po, Principe, and São Tomé lie in the Gulf of Guinea on a line running nearly southwest from Mount Cameroon. This most recent analysis of the interesting avifauna of this group of islands is based on a collection made in 1928 and 1929 by Mr. and Mrs. José G. Correia. In the paper are included an annotated list of species and subspecies, a list of the birds of each island (including Annobon, which the Correias did not visit), and sections on zoogeography and evolutionary factors. *Treron australis virescens* (Principe), *Cuculus solitarius magnirostris* (Fernando Po), *Cyanomitra cyanolaema octaviae* (Efulen, Cameroons), *Hypargos nitidulus virginiae* (Fernando Po), and *Oriolus nigripennis alleni* (Bangah, Liberia) are described as new. The genera *Lampribis* and *Hagedashia* are combined with *Bostrychia*, and *Crecopsis* with *Crex*. (In the summary *Creciscus* was substituted, apparently inadvertently, for *Crecopsis*.)

The taxonomic part of this paper furnishes an up-to-date summary of the avifauna of this island group and is a valuable contribution to the systematics of African birds. Of greater general interest in Amadon's analysis of some of the evolutionary trends in the birds of these islands. As was to be expected, there is a direct proportion between the number of endemic subspecies, species, and genera on an island and the island's distance from the mainland. This is modified to some extent by the size of the island. On these islands, the absence of any adaptive radiations comparable with those in the Galapagos finches and the Hawaiian honey-creepers is accounted for by the linear arrangement of the islands, by the long distances separating them, and by their closeness to the mainland from which invasions of a relatively great number of species have occurred, thus filling more ecological niches with unrelated forms.

Although the endemic forms on Fernando Po, the nearest of the islands to the mainland, show no definite trends in variation of color and pattern, those of the outer islands show a marked tendency toward more subdued colors and less sharply defined patterns than related forms on the mainland. It is suggested that on the islands with poor avifaunas, the patterns and colors which serve as recognition marks for species on the mainland are gradually lost. That this is so is further indicated by the fact that these patterns are usually not lost when two or more closely related species occur on the same island.

Variations in general size and size of bill are also discussed, and several stimulating ideas are presented on these subjects. This paper should be widely consulted by everyone interested in insular faunas.

Errors in the summary include the statement that all the birds described as new in this paper were from Fernando Po (one was from Principe), the substitution of *Creciscus* for *Crecopsis* mentioned earlier, a misspelled generic name, and a misleading sentence. Such slips are difficult to excuse, especially in a publication of an institution with the reputation of the American Museum; and they impair the value of this important paper by suggesting that other such errors may lie elsewhere in the text.—ROBERT W. STORER.

A Comparison of Variation, Behavior and Evolution in the Sea Bird Genera Uria and Cepphus.—Robert W. Storer. Univ. Calif. Publ. Zool., 52, 1952: 121–222, plates 1–2, 19 figures in text. $1.25.—This is a comprehensive treatise of the variation in the murres and guillemots, based on extensive material. The author has examined no less than 3157 specimens in various museums. The biometric comparison is elucidated by using population range diagrams, after the method of Hubbs and Perlmutter. In this way a large amount of data can be compressed into a minimum space. When such large samples are compared with painstaking exactness the geographical variation certainly appears to be smaller than hitherto assumed. Nevertheless, all forms recognized in recent handbooks and monographs are upheld by the author, with the exception of one. In birds like the alcids with a very wide range of variation in most characters a thorough statistical treatment of the material is of great significance. When in *Uria l. lomvia* from Baffin Bay the variation in wing-length is 204–227 mm. (81 specimens measured) and in *U. l. arra* from Bering Strait 210–240 (71 measured), these two well-established subspecies scarcely appear to be separable, according to the 75 per cent rule, but the mean is 213.8 on *lomvia* and 225.5 in *arra*, with standard errors of only 0.6 and 0.7 and standard deviations of 5.25 and 5.90 respectively, which shows that the two populations differ considerably. Apparently the greater part of the material has consisted of breeding birds, which of course is an advantage when comparing populations of migratory birds. However, a number of races of *Cepphus grylle* differ more in winter than in summer-plumage. Storer does not describe these differences, nor those in the juvenile plumages. If the geographical variation in these plumages had been considered, Storer would probably not have united the low-arctic *C. g. arcticus* and the boreal *C. g. atlantis*, as these forms differ in winter-plumage although they are almost identical in summer-plumage.

There is an instructive chapter on water temperature and distribution, in which it is shown that the guillemots with much white in the plumage are extreme high-arctic forms. The ranges of the various species and subspecies of auks are closely correlated with water temperature, and the white color of the arctic forms is no doubt an adaptation to the low water temperatures. The larger size of certain Baltic sea-birds is correlated, according to Storer, with low salinity, a theory which sounds

plausible. On the other hand, I am not in agreement with the author when, in a chapter on population size, he puts forward a theory to explain the fact that, in an area suitable to the existence of both murres and guillemots, the population size of the murres is roughly the square of that of the guillemots. The limiting factor for the guillemots is said to be the number of available nest-sites, this being of a linear value, while in the murres the population number is restricted by the food supply, this being two-dimensional. That this cannot be the right explanation appears from a closer study of the life-habits of the two groups and is further borne out by the fact that the Razorbill (*Alca torda*), which has similar feeding habits to the murres, occurs in smaller numbers even than the guillemots.

Under the heading "Variants" the well-known *ringvia* and *motzfeldi* mutants are briefly dealt with, as are the more accidental albinisms; the number of these in collections is however far greater than appears in the paper.

In the ecological part there are some good sketch drawings of various postures, but these chapters do not contain much new information and are, besides, far from complete.

According to the introduction the present investigation was undertaken primarily in order to compare the effects of various innate and environmental factors on the evolution of the murres and guillemots. The author admits, however, that these birds are ill-suited to genetic analysis, and consequently the chapter on evolution and speciation deals largely in generalities.

The taxonomic appendix contains a synopsis of all the known forms of murres and guillemots, 5 species with a total of 21 subspecies. This is a far cry from Hartert's treatment of these birds in "Die Vögel der paläarktischen Fauna," in which only 9 subspecies were recognized, and shows how much more we now know about these birds. A few remarks may be added: In the range of *Cepphus g. arcticus* (p. 196) southeastern Greenland has been omitted, but it is rightly shown on the accompanying map. The murre of the Iberian Peninsula has recently been separated by Spanish ornithologists. The wintering grounds of *Uria a. hyperborea* are said to be "not definitely known," but specimens of this form have been obtained in winter from the Murman Coast right down to western Sweden.

The chief value of this work is in the excellent treatment of the enormous material examined by the author. The statistical analysis of all samples makes the variation very clear to the reader, and the last word is now probably said on the taxonomy of most of these forms. The author is to be congratulated on this fine piece of work.—FINN SALOMONSEN.

Crip, Come Home.—Ruth Thomas, illustrated by Aldren Watson. (Harpers, New York.) 175 pp. 7 line drawings, 2 plates. 1952. Price, $2.50.—This is a chronicle of a color-banded Brown Thrasher (*Toxostoma rufum*) that lived for ten years in the author's garden in central Arkansas. A book for the general reader, its literary qualities need not blind the ornithologist to its intrinsic merit as a life history study. The accounts of pair formation, nesting, parental care, relations between mates and former mates, and between neighbors—all these give an insight into the behavior of a highly intelligent and individualistic species. A vivid picture is presented of the environment—the weather throughout the year, the plants and the many other birds through the seasons. It is a fine thing to have, instead of the trite and trashy stuff that fills most popular bird books, such authentic observation and interpretation presented to the public.—MARGARET M. NICE.

King Solomon's Ring. Konrad Z. Lorenz. (Thomas Y. Crowell, New York). xxi + 202 pp., 1952. $3.50.—Many American scientists appear to consider the

writing of "popular" books and articles beneath them. This seems based in part on a justifiable aversion to many writers in this field who continue to offer their readers works in which truth is sacrificed for effect. Among many scientists there is also a feeling, possibly stemming from unconscious envy, that they are unable to write well and that they are best serving science by preparing the results of their research only in technical reports. While it does not come easily to some, most intelligent people who are willing to take the trouble can learn to write simply and clearly. Presenting the results of our scientific work to the public in terms which it can understand is necessary for two reasons. Much of the research carried on in this country is supported directly or indirectly by the public; it is its right to know what progress is being made. And perhaps more important, interest must be aroused in the many potential scientists who are needed more than ever before to expand our technical fields of endeavor. Popular writing and lecturing have long been considered obligations by German workers, and this is doubtless one reason that country has produced such an array of noted scientists. We might well emulate them.

Konrad Lorenz is an eminent product of this tradition; a world-famous animal psychologist whose literary style maintains its freshness even in translation. After enjoying chapters filled with amusing anecdotes and pages bordered with the author's deft sketches, we find that we have also learned many things about his fish, water shrews, dogs, and Jackdaws. Through a greater understanding of them, we have learned how to know better the animals around us; and thus we find that we have learned many principles of animal psychology. Who knows how many young people will find here the spark needed to bring them into this field?

It is unfortunate that the publisher did not see fit to have the book better edited from a mechanical standpoint. In most instances, punctuation marks appear outside the quotation marks; and in the wholly inadequate index containing the scientific names of only 17 birds, no less than eight of these are misspelled. Such matters, however, seldom offend anyone but editors, who seem damned to an existence of searching for just such minutiae. I do not hesitate to recommend this book to all who have an interest in animals, from dog-owners to professional biologists. From it, the former will find greater understanding of their pets; many of the latter might profit by its example.—ROBERT W. STORER.

Bird Recognition II. Birds of Prey and Water-fowl.—James Fisher. (Penguin Books Ltd., Harrison and Sons Ltd., Harmondsworth, Middlesex, England), 182 pp. 1951. Price, $0.85.—Owls, hawks, herons, ducks, grebes, and loons are treated in the second of a projected series of four paper-bound books on the identification of British birds. (The first of the series covers the water birds not discussed in the present volume. Volume 3 on game birds and the larger perching birds and volume 4 on the smaller perching birds are in preparation.)

Under the species accounts are discussed recognition, breeding, and distribution and migration. For each species, illustrations include distribution maps, a wash drawing of the bird, and an ingenious circular graph indicating its status in the British Isles throughout the year. A chart giving the habitats in which each species is regularly found, a key to the species treated, a series of drawings showing many of the species in flight or in winter plumage, a list of extreme rarities, and an index complete the volume. Careful planning has gone into the organization of this book which contains a large amount of information clearly presented. It should prove extremely useful as a field guide, and its low price will make it available to an unusually large number of people.—ROBERT W. STORER.

Bird Songs of Dooryard, Field, and Forest.—Recorded by Jerry and Norma Stillwell. (Jerry E. Stillwell, R. F. D. 2, Fayetteville, Arkansas.) $7.95. This most recent set of recordings of wild bird songs, by Jerry and Norma Stillwell, is most welcome. It consists of a single disk, on the two sides of which the songs and calls of forty-nine different species have been recorded. This has been accomplished by recording at the lower speed of 33⅓ rpm.

An outstanding feature of these recordings is that, for many of the species, a number of different variations of the song, as well as the call-note, are recorded. This has been done to a greater extent than in other records with which I am familiar, and it should help the student of bird songs to distinguish between those characters of a song that are specific, and those that are only individual. For example there are four songs of the Cardinal and nine of the Eastern Meadowlark. The Red-eyed Towhee calls "chewink" and then sings his "drink your tea" in three different ways. Five different Field Sparrows sing for us, each definitely Field Sparrow, and each at the same time entirely individual. The Bob-white not only sings his familiar whistle, but also the "scatter" call and the "caterwaul."

The announcer's explanations concerning the characters of many of the songs, that seem confusing at first to the beginning student, are helpful. For example the distinguishing characters of the songs of the Catbird, Brown Thrasher, and Mockingbird are first stated, and then demonstrated by the records.

Because bird songs are high in pitch and the notes very rapid, we often have difficulty in hearing all that there is in a song. We cannot appreciate the full richness of quality of certain songs, because the overtones that cause that quality are too high for us to hear. But when mechanical records are slowed down to half the actual speed at which the bird sang, the songs are slower, and the pitch an octave lower. Where we heard a trill, we hear a series of notes that can be counted.

In this set of records this has been done for the Carolina Chickadee and the Bewick Wren. The results are surprising, both in notes that were formerly inaudible and in a superior richness of quality that we would not have suspected.

Among the records on this disk are not only a greater variety of songs of species that are previously recorded elsewhere, but there are also songs of nine species that have not, to my knowledge, been previously recorded on disks available to the public.

Both for those who are learning to recognize the bird songs and for those who already know them but are studying them in greater detail, these records are exceedingly helpful. We owe to Mr. and Mrs. Stillwell a debt of gratitude for the long, patient, and difficult work that must have been necessary to record successfully, select, and put together on one disk, this splendid collection of songs and calls of our familiar birds.—ARETAS A. SAUNDERS.

ALDRICH, JOHN W. 1952. The source of migrant Mourning Doves in southern Florida. Journ. Wildl. Mgt., **16:** 447–456, 2 figs., 1 table.—*Zenaidura macroura* shot in this region and especially at Key West migrate from a very extensive area east of the Mississippi, possibly from the extreme northern periphery of the range of the species. Of 299 examined in 1950, 77 per cent were immature or juvenile.—J. J. H.

ARNY, SAMUEL A. 1952. Taxonomic status of the bank swallow of North America. Condor, **54:** 356–357.—Two specimens from North America reported as *Riparia riparia ijimae* resemble this Siberian race merely because of color differences between fresh and older, "foxed" skins. The North American population of *Riparia riparia* is separable from that of Europe and Asia on the basis of two mensural

characters and should be recognized. The name *R. r. maximiliani* (Stejneger) is available for this population.—W. H. Behle.

ATTWELL, (MRS.) G. D. 1952. The breeding of the Cardinal Woodpecker [*Dendropicos fuscescens*] at Gatooma, Southern Rhodesia. Ostrich, **23:** 88–91.—It was the male which remained in nest hole overnight with young.

AUSTIN, OLIVER L., JR. 1952. Notes on some petrels of the North Pacific. Bull. Mus. Comp. Zool., Harvard, **107:** 391–407, 4 figs., 4 tables.—Taxonomic; *Pterodroma, Oceanodroma,* and the forms of these.

AUSTIN, OLIVER L., SR. 1953. A Common Tern at least 23 years old. Bird-Banding, **24:** 20.—A *Sterna hirundo,* banded as an adult at Chatham, Mass., July 26, 1929, was found killed by an owl July 6, 1952. This bird could not have been less than 24 years old and almost undoubtedly was older, since "less than two-percent of this species breed when one year old and less than one-fourth before their third year."—M. M. Nice.

BAUMGARTNER, FREDERICK M., MEREDITH J. MORRIS, JOHN L. STEELE, and JACK E. WILLIAMS. 1952. Oklahoma Bobwhite food relations. Trans. 17th N. A. Wildl. Conf., pp. 338–359, 2 figs., 3 tables.—Acorns, ragweeds, panic grasses, and sumacs were of statewide importance in some 1,771 crops of *Colinus virginianus* collected from November through April. The leading foods varied somewhat from one part of the state to another.—J. J. H.

BENTON, ALLEN H. 1952. The Red-eyed Vireo as a Mocker. Kingbird, **2:** 40.—An individual in Cayuga Co., N. Y., imitated the calls of at least four other species.—H. D. M.

BISWELL, H. H., R. D. TABER, D. W. HEDRICK and A. M. SCHULTZ. 1952. Management of chamise brushlands for game in the North Coast region of California. Calif. Fish and Game, **38:** 453–484.—*Lophortyx californica* in late summer has densities of about 100 per sq. mile of heavy brush at 1500–2000 ft. elevation, 250 in opened brush, and 40 per square mile at 2000–2500 feet. Parallel densities for *Oreortyx picta* run 50–80, as many as 140–150, and perhaps 160.—J. J. H.

BLAKE, CHARLES H. 1953. Turnover Ratios. Bird-Banding, **24:** 7–10.

BOASE, HENRY. 1952. Mallard Counts in the Tay Estuary and in Angus. Brit. Birds, **45:** 377–386.—Records of *Anas platyrhynchos* extending over nearly 40 years.

BOULTON, RUDYERD, and A. L. RAND. 1952. A collection of birds from Mount Cameroon. Fieldiana-Zool., **34:** 35–64.—An annotated list describing a collection of 274 specimens taken in the area. A short description of the mountain habitats is given. For many of the species brief mention is made of habitats and altitudinal range.—P. S. H.

BRADFIELD, R. D. 1944 (privately printed), 1952 (reprinted). New South African Ornithological records and new forms. Ostrich, **23:** 127–128.—New subspecies: *Falco peregrinus wallichensis* from Swakopmund, South Africa; *Certhilauda subcoronata kaokoensis* from Messum River, southern Africa; and *Zosterops capensis haigamchabensis* from "Haigamchab, Goanikontes, Swakopriver," southern Africa.

BROWNLOW, H. G. 1953. The Design, Construction and Operation of Heligoland Traps. Brit. Birds, **45:** 387–399, 5 figs. detailed descriptions, illustrated with 5 figures.

BUE, I. G., LYTLE BLANKENSHIP, and WILLIAM H. MARSHALL. 1952. The relationship of grazing practices to waterfowl breeding populations and production on stock ponds in western South Dakota. Trans. 17th N. A. Wildl. Conf., pp. 396–414, 1 fig., 2 photos, 8 tables.—As a direct result of the U. S. Department of

Agriculture's encouragement of the development of stock ponds for cattle, nesting waterfowl have markedly increased in the short-grass country. In Stanley County, which had 1,850 artifically built ponds in 1951, 6 kinds of dabblers averaged 7.7 pairs and raised 29 young per square mile. In this year, 24 ducks were raised per pond (one-eighth to 10 acres in size). Frequency of nests tended to be inversely proportional to grazing pressure. The acquisition of new range reported in this paper appears to be a dramatic response to a range-management technique which was conceived originally without any thought of its wildlife implications. It not only illustrates the increasing importance of man as a factor controlling animal distribution on the North American continent, but it also provides some refutation of Hochbaum's hypothesis regarding the failure of waterfowl to nest today on many marshes in the northern tier of states. Hochbaum argues that the annihilation of the 19th-century breeding stock by overshooting on such water areas has resulted in a loss of breeding tradition; the progeny of today's birds tend to return to the homes of their parents. In line with this hypothesis, some state conservation agencies today are trying to restock their "shot-out" marshes with breeding ducks transplanted from the Prairie Provinces. This technique will probably be effective only when the experimental birds or their progeny are not subject to too heavy or too early shooting. Ducks invading the cattle-range country of South Dakota were common or fairly common surface-feeding species that were subject to significant shrinkage of habitat through drainage operations immediately to the east. Hochbaum's hypothesis could still hold for certain diving ducks which possess quite different internal population pressures of their own.—J. J. Hickey.

BUSS, IRVEN O., CARL V. SWANSON, and DAVID H. WOODSIDE. The significance of adult pheasant mortalities in spring to fall populations. Trans. 17th N. A. Wildl. Conf., pp. 269–284, 5 figs., 5 tables.—Climate, mainly precipitation, delayed the peak of hatching in two years and accelerated adult mortality enough in one to depress the fall population.—J. J. H.

CARTWRIGHT, B. W. 1952. A comparison of potential with actual waterfowl production. Trans. 17th N. A. Wildl. Conf., pp. 131–137.—Based upon a number of assumptions, the author considers some model populations and comes to the conclusion that: (1) approximately 80 per cent of female ducks succeed in producing young in a favorable breeding season, (2) the fall juvenile component of the total population then approaches 70 per cent. The former of these values is a bit higher than similar statistics for gallinaceous birds reported by investigators working with better field data; Cartwright's rests on the assumption that *all* ducks renest following destruction of their first nest—a hypothesis for which I do not think he can get critical support at this time. Although his analysis is rather oversimplified (viz. no consideration of summer mortality among the young), the result is probably close to being correct. The second conclusion on fall age ratios (70 per cent young) is in line with an estimate of 68 per cent for Mallards on September 1 derived from a small sample of banding data by the reviewer in Fish and Wildlife Service Spec. Sci. Rept.: Wildl. No. 15; both statistics hold for average conditions only.—J. J. Hickey.

CARTWRIGHT, BERTRAM W., and JEAN T. LAW. 1952. Waterfowl Banding 1939–1950 by Ducks Unlimited. (Ducks Unlimited, Winnipeg), pp. 1–53.—Includes much material on returns.

CHATTIN, JOHN E. 1952. Appraisal of California waterfowl concentrations by aerial photography. Trans. 17th N. A. Wildl. Conf., pp. 421–426.—Aerial censuses

yield greater accuracy than do the conventional types, probably cost less, and yield a permanent record. Swans, geese, and coots are poor subjects. Photography is especially valuable when extremely large concentrations must be inventoried.—J. J. H.

COLLINS, HENRY C., JR. 1952. Birds of Massachusetts. (Caribou Press, Bronxville, N. Y.) 16 pp., illustrated in color and in black and white by Roger Tory Peterson (most figures reprinted from his field guide). $0.25.

COLLINS, HENRY H., JR. 1952. Birds of the Everglades. (Caribou Press, Bronxville, N. Y.) 16 pp., illustrated in color and in black and white by Roger Tory Peterson. $0.25.

COWAN, I. MCT., and JAMES HATTER. 1952. A trap and technique for the capture of diving waterfowl. Journ. Wildl. Mgt., **16:** 438–441, 3 figs.—A drive trap with long leads has been successful in catching over 7,000 diving ducks in British Columbia. Special care was taken in placing the trap. *Bucephala islandica* comprised the bulk of the catch.—J. J. H.

COWAN, JOHN B. 1952. Life history and productivity of Western Mourning Doves in California. Calif. Fish and Game, **38:** 505–521, 2 figs., 4 photos, 7 tables.—Winter flocks of *Zenaidura macroura* mostly involved paired birds which nested from mid-March to September 20. Each pair attempted 5.1 nestings in a season and produced 6.3 nestlings, 25 per cent using the same nest after each successful brood. One pair apparently used the same nest six consecutive times successfully; 65 per cent of the nests were successful.—J. J. H.

CRAMP, S., and W. G. TEAGLE. 1952. The Birds of Inner London. Brit. Birds, **45:** 433–456.

LE DART, R. 1952. Note sur la capture de la rarissime *Gallinago Sabini* (Vigors). Alauda, **20:** 109.—First capture of the dark variant of *Capella gallinago* in France.

DAVIS, L. IRBY. 1952. Winter bird census at Xilitla, San Luis Potosi, Mexico. Condor, **54:** 345–355, 1 fig.—A one day census was made in 1950. In 1951, 24 people made observations from November 22, 1951, to January 5, 1952, spending 305½ hours in the field and recording 238 species. These are listed for 13 areas with the largest number of each species seen in one day being given for each area. Comparison is made with the results of 1950.—W. H. Behle.

DORST, JEAN. 1952. Contribution à l'étude de la langue des Méliphagidés. L'Oiseau, **22:** 185–214, 14 figs.—A detailed and illustrated description of the structure of the tongue which is shown to be far from uniform in this group. The author concludes that the family Meliphagidae as now understood is a composite and not a natural group.

ENG, ROBERT L. 1952. A two-summer study of the effects on bird populations of chlordane bait and aldrin spray as used for grasshopper control. Journ. Wildl. Mgt., **16:** 326–337, 6 tables.—Bird mortality appeared to be in direct proportion to the grasshopper kill and not directly to toxicity of the insecticides applied at the usual rates.—J. J. H.

EVENDEN, FRED G., JR. 1952. Waterfowl sex ratios observed in the western United States. Journ. Wildl. Mgt., **16:** 391–393, 2 tables.—Large samples disclosed 126 Mallard males, 136 Pintail males, and 152 Shoveller males for each 100 females over a 9-year period. Sex ratios were balanced in Baldpate and Gadwall and tended to be unbalanced in 13 other species of ducks. Some simple biometrical analyses would have helped this presentation.—J. J. H.

FERRY, C. 1952. A propos d'une variante de chant de *Sylvia atricapilla*. Alauda, **20:** 109–112.

FINLAY, H. J. 1952. Microfaunal notes on matrices associated with fossil penguin bones. New Zealand Geol. Surv., Paleo. Bull. No. **20**: 58–64.—Evidence of remains of foraminifera associated with fossil penguins indicates the deposits are Oligocene, not Miocene.

FLASAR, IVO. 1951. Orel královský (*Aquila heliaca* Sav.) v Československu. Sylvia; **13**: 89–93.—The Imperial Eagle (*Aquila heliaca* Sav.) in Czechoslovakia. French summary.

GILBERT, O., T. B. REYNOLDSON, and J. HOBART. 1952. Gause's hypothesis: an examination. Journ. Anim. Ecol. **21**: 310–312.—The authors discuss difficulties in the concept that no two species with similar ecology can live together in the same place. Actually, Gause drew no general conclusion from his laboratory experiments and made no statement which resembles any wording of the hypothesis which bears his name. However, in a population of a species, mechanisms which reduce competition between it and populations of other species tend to persist.

GREENWAY, JAMES C., JR. 1952. *Tricholimnas conditicius* is probably a synonym of *Tricholimnas sylvestris*. Breviora (Mus. Comp. Zool.), No. **5**: 1–4.

GULLION, GORDON W. 1952. Some diseases and parasites of American Coots. Calif. Fish and Game, **38**: 421–423.—Of 48 freshly trapped *Fulica americana*, 42 were infected, mostly by helminth parasites. Fungal infections in 3 were traced to *Aspergillus flavus*. One coot which died in captivity was heavily infested by the roundworm *Amidostomum raillieti*. Mites in the nasal processes of 3 proved to be a species new to science.—J. J. H.

HACHISUKA, MASAUJI. 1952. Bibliography of Chinese Birds. Quart. Journ. Taiwan Mus., **5**: 71–209.—A rather fully annotated list of mostly faunistic papers dealing with the birds of North China, the Yangtze Valley, and South China, with some Sikang and Tonkinese literature. Papers dealing with Hainan and Formosa are not included.

HALE, JAMES B. and DONALD R. THOMPSON. 1952. Small game hunting prospects 1952. Wisconsin Cons. Bull., **17**(9): 3–7.—Populations of *Bonasa umbellus* are still high, those of prairie grouse low, those of other gallinaceous birds show little change.—J. J. H.

HARRIS, STANLEY W. 1952. A throw net for capturing female waterfowl on the nest. Journ. Wildl. Mgt., **16**: 515, 1 fig.

HART, CHESTER M., JOHN F. DAVIS, and WILBUR F. MYERS. 1952. Pheasant cooperative hunting area results, 1951. Calif. Fish and Game, **38**: 597–604, 3 figs., 5 tables.

HANSON, WILLIAM R. 1952. Effects of some herbicides and insecticides on biota of North Dakota marshes. Journ. Wildl. Mgt., **16**: 299–308, 5 tables.—Chlordane and toxaphene were found to have lethal effects upon young birds that swim or dabble in the water.—J. J. H.

HAUGEN, ARNOLD O., and JAMES KEELER. 1952. Mortality of Mourning Doves from trichomoniasis in Alabama in 1951. Trans. 17th N. A. Wildl. Conf., pp. 144–151, 1 fig., 5 tables.—*Trichomonas gallinae* is estimated to have killed 25,000–30,000 doves in the breeding season.—J. J. H.

HERMAN, CARLTON M. 1953. Recognition of Trichomoniasis in Doves. Bird-Banding, **24**: 11–12.

HOWARD, HILDEGARDE. 1952. The prehistoric avifauna of Smith Creek Cave, Nevada, with a description of a new gigantic raptor. Bull. Southern Calif. Acad. Sci., **51**: 50–54, 2 figs.—Fifty avian species are listed from this Quaternary cave deposit. Most outstanding is *Teratornis incredibilis*, new species, represented by a single carpal bone 43 per cent larger than that of *Teratornis merriami*.—H. H.

IRWIN, MICHAEL P. STUART. 1952. Notes on some Passerine birds from Mashonaland, Southern Rhodesia. Ostrich, **23**: 109–115.

JAHN, LAURENCE R. 1952. Helping hand for waterfowl. Wisconsin Cons. Bull., **17**(9): 15–19.—In 1951, Wisconsin hunters reported killing about 676,000 birds. Research indicates that an additional 125,000–140,000 were crippled and left in the weeds.—J. J. H.

JAHN, LAURENCE R., and RUTH L. HINE. 1952. What about goose refuges? Wisconsin Cons. Bull., **17**(12): 12–13.—About 40,000 *Branta canadensis* now stop in Wisconsin each fall, 4 refuges serving as ecological dams retarding the southward flow of geese.—J. J. H.

JIRSÍK, JOSEF. 1951. K otázce ras strnada rákosního (*Emberiza schoeniclus*) v ČSR. Sylvia, **13**: 125–132, 1 plate, 1 table.—Contribution to the question of the races of the Reed Bunting (*Emberiza schoeniclus*) in Czechoslovakia. English summary.

JOHNSON, NED K., and FRANK RICHARDSON. 1952. Supplementary bird records for Nevada. Condor, **54**: 358–359.—Additional information on distribution or seasonal occurrence of 12 species.—W. H. Behle.

JONES, D. W., and G. M. KING. 1953. Observations of *Cinclus cinclus* in a salmon tank. Brit. Birds, **45**: 400–401.—The "bird can only reach stray eggs which will never have the chance to develop, and therefore the Dipper must not be regarded as an enemy of the salmon."

KILLPACK, MERLIN L., and DON N. CRITTENDEN. 1952. Starlings as winter residents in the Uinta Basin, Utah. Condor, **54**: 338–344, 3 figs.—Observations were made during the winters of 1947 to 1951. The starlings arrive about November 5 and leave about the first week in April. An analysis of contents of 95 stomachs is given, the major foods being fruits of the Russian Olive, grains, garbage, and corn silage. They roost with English Sparrows in holes dug in the roofs of open-fronted, straw-thatched cattle shelters.—W. H. Behle.

KOZICKY, EDWARD L. 1952. Variations in two spring indices of male Ring-necked Pheasant populations. Journ. Wildl. Mgt., **16**: 429–437, 3 figs., 3 tables.—Statistical analyses of the relative variability of crowing counts and roadside counts. Wind velocities, presence of dew, and relation to sunrise were found to have significant effects on test runs. Population trends for any 10-mile route require 9 random repetitions of the crowing count, 6 of the roadside count, in order to obtain results within 10 per cent of the true mean.—J. J. H.

KOZICKY, EDWARD L., GEORGE O. HENDRICKSON, PAUL G. HOMEYER and EVERETT B. SPEAKER. 1952. The adequacy of the fall roadside Pheasant census in Iowa. Trans. 17th N. A. Wildl. Conf., pp. 293–305, 3 figs., 5 tables.—Statistical analyses of Iowa's attempt to estimate differences in population levels of *Phasianus colchicus*.—J. J. H.

LABITTE, ANDRÉ. 1952. Contribution à l'étude de la biologie de reproduction de la pie-grièche écorcheur *Lanius collurio* L. Alauda, **20**: 102–108.—Notes on population density, nesting, incubation, and the young over a period of eleven years.

LEACH, E. P. 1953. British Recoveries of Birds Ringed Abroad. Brit. Birds, **45**: 458–465.

LEOPOLD, A. STARKER and ROBERT H. SMITH. 1953. Numbers and winter distribution of Pacific Black Brant in North America. Calif. Fish and Game, **39**: 95–101, 1 fig., 1 table.—About 175,000 *Branta nigricans* were inventoried in 1952, 63 per cent of them in Baja California.—J. J. H.

LISTMAN, WALTER. 1952. Noteworthy Records—October, 1952. Goshawk, **5**:

53.—Parasitic Jaeger and Sabine Gull on Lake Ontario near Rochester, N. Y., October 4, 1952.—H. D. M.

LISTMAN, [WALTER,] and [H.] VAN BEURDEN. 1952. Noteworthy Records—November 1952. Goshawk, **5**: 58–59.—Kittiwake at Lighthouse Beach, Lake Ontario, Monroe Co., N. Y., November 8, 1952.—H. D. M.

MACDONALD, J. D. 1953. Taxonomy of the Karroo and Red-backed larks of western South Africa. Bull. Brit. Mus. (Nat. Hist.), Zoology, **1**: 321–350, pls. 36–38, 5 figs.—These two forms, formerly regarded as distinct species and sometimes placed in different genera, are considered to belong to the same species, *Certhilauda albescens*. Seven subspecies of this species are recognized from South Africa, and two of these, *Certhilauda albescens patae* and *C. a. cavei* are described as new.—R. W. S.

MARPLES, B. J. 1952. Early Tertiary penguins of New Zealand. New Zealand Geol. Surv., Paleo. Bull. No. 20: 1–57, 6 figs., 11 tables, 8 pls.—Four new genera and five new species are proposed. The fossil penguins of New Zealand are of the lower Oligocene, not Miocene as has been usually believed. The differences between Recent penguins and certain fossil ones from Seymour Island, South Australia, and New Zealand are such that these fossil forms are placed in the Subfamily Palaeeudyptinae and the Recent ones in the Spheniscinae. [See also, Finlay, H. J. 1952].—Harvey I. Fisher.

MATOUŠEK, B. 1951. Hnízdění rybáka malého (*Sterna albifrons* Pall.) na Slovensku. Sylvia, **13**: 86–88, 1 plate.—Nesting of the Least Tern (*Sterna albifrons*) in Slovakia. French summary.

MATOUŠEK, B. 1951. Příspěvek k biologii vlhy evropské (*Merops apiaster*) na Slovensku. Sylvia, **13**: 122–125, 1 plate.—Contribution to the biology of the Bee-eater (*Merops apiaster*) in Slovakia. English summary.

MAYAUD, NOËL. 1952. Le phylum marin d'*Anthus spinoletta*. Ses particularités écologiques et morphologiques. Alauda, **20**: 65–79.—This species is divisible into two natural groups, the water pipits (or the *spinoletta* group to which belong the North American populations), and the rock pipits (the *petrosus* group). These two groups are separated ecologically and replace one another geographically. The *petrosus* group "le phylum marin" is restricted to the rocky coasts of Europe while the *spinoletta* group is very widely distributed throughout the whole of the Holarctic, chiefly in mountainous regions.

Mayaud deals with the *petrosus* group. Its races are rather poorly differentiated by differences in coloration caused, in some regions, by differences in the extent or lack of a prenuptial molt. The present reviewer had reached, independently, the same conclusion which is stated by Mayaud as follows: "If this molt is rather complete the bird acquires a nuptial plumage, i. e. a *littoralis* phenotype; if there is no prenuptial molt—or a partial molt—the prenuptial plumage persists and the bird has a *petrosus* phenotype." According to Mayaud and the findings of the reviewer, this molt does not occur (or is limited to a very few feathers) in the populations of *kleinschmidti* in the Faeroes, *petrosus* in Scotland, Great Britain and ? coast of Norway, but is complete (or virtually so) in the populations of *littoralis* of the Baltic and White Sea. The reviewer was not aware, however, that the breeding populations of the coasts of western and southern Brittany and region to the south were composed of individuals of both types.

Mayaud speculates on the factors influencing the geographical variations in the molt. Clouds and much reduced amount of sunlight may inhibit the endocrine mechanism responsible for the molt at least in the populations of the Faeroes,

Scotland, and Great Britain. These populations are largely sedentary while the populations of the Baltic and the White Sea migrate to the more sunny coasts of France or regions to the south, but the presence or lack of the molt in the populations of Brittany and to the south remains unexplained. A full nomenclature and synonymy of the rock pipits is given.—C. Vaurie.

MAYR, ERNST, and E. THOMAS GILLIARD. 1952. Altitudinal hybridization in New Guinea honeyeaters. Condor, **54**: 325–337, 4 figs.—Hybrid populations of two subgroups of the *Melidectes leucostephes-belfordi* group of honeyeaters are analyzed. The two groups, called "wattle-birds" and "black-bills," interbreed freely in a broad area of contact in the mountains of central New Guinea. A hybrid index for the several characters was calculated, an analysis of which shows six hybrid populations. In the hybrid zone, those populations taken at low altitudes show a prevalence of wattle-bird characters while birds of high altitudes have a prevalence of black-bill characters. Outside the hybrid zone black-bills and wattle-birds may range from 1600 to 3300 meters with no altitudinal variation of morphological characters except size. The interpretation is that the two groups attained morphological distinctness but not reproductive isolation in geographic isolation. When, after the breakdown of extrinsic isolation, these two kinds of honeyeaters met, they interbred freely. However, since their respective gene complexes had become correlated with a preference for and higher viability at different altitudes, there is now different genetic composition at different altitudes, presumably maintained by selection.—W. H. Behle.

MCLAUGHLIN, CHARLES L., and DAVID GRICE. 1952. The effectiveness of large-scale erection of Wood Duck boxes as a management procedure. Trans. 17th N. A. Wildl. Conf., pp. 242–259, 4 figs., 2 tables.—State personnel erected nearly 2,000 nesting boxes and distributed 4,000 more to clubs throughout Massachusetts. Some 89 per cent of the state-erected boxes proved to be functional, and 45 per cent of these were used by ducks; 64 per cent of 1,427 nests were successful. The Wood Duck population has apparently doubled wherever the wooden boxes have been erected. [In Illinois, F. C. Bellrose is using elliptical holes (4 x 3 inches) and boxes of 12-inch stove pipe with a steep conical top to reduce or eliminate predation.]—J. J. H.

MEES, G. F. 1952. Notes sur quelques oiseaux de la Corse. Alauda, **20**: 80–84.

MOREAU, R. E. 1952. The place of Africa in the palaearctic migration system. Journ. Anim. Ecol. **21**: 250–271.—A general discussion.

MURPHY, DEAN A., and THOMAS S. BASKETT. 1952. Bobwhite mobility in central Missouri. Journ. Wildl. Mgt., **16**: 498–510, 3 figs., 4 tables.—Presumably unmated *Colinus virginianus* ranged up to one-half mile in a single summer day, but generally remained within an area one-fourth to one-half mile in diameter at this season. No extensive fall shuffle was evident. Most fall and winter coveys remained within a distance of one-quarter mile to three-eighths mile. Spring dispersal distance were also short.—J. J. H.

MURPHY, ROBERT CUSHMAN, and JESSIE PENNOYER SNYDER. 1952. The "*Pealea*" phenomenon and other notes on storm petrels. (Birds collected during the Whitney South Sea Expedition, no. 62.) Amer. Mus. Novit., No. 1596: 1–16.—A discussion of specimens of storm petrels with spotted or streaked plumage, an aberrant condition that is known from several species. Such abnormal birds have been grouped in a heterogeneous "genus" *Pealea*. In disposing of this, the authors set forth taxonomic notes and measurements for a number of hydrobatids.—D. A.

NAYLOR, ALBERT E. 1953. Production of the Canada Goose on Honey Lake

Refuge, Lassen County, California. Calif. Fish and Game, **39:** 83–94, 3 figs., 3 tables.—Seventeen cover-types were used by *Branta canadensis* for nesting; mean clutch size was 5.5, nest success 68 per cent; 24 per cent were deserted, 8 per cent destroyed. Preseason predator control, construction of islands, and control of vegetation are recommended.—J. J. H.

PARMALEE, PAUL W. 1952. Ecto- and endoparasites of the Bobwhite: their numbers, species, and possible importance in the health and vigor of quail. Trans. 17th N. A. Wildl. Conf., pp. 174–188, 1 fig., 3 tables.—Six species of lice, 2 of ticks, 1 flea, 6 cestodes, nematodes, and worms were found on *Colinus virginianus* in the Post Oak region of Texas. Degree of contamination is by covey unit not by age groups.—J. J. H.

POOLE, DANIEL A. 1952. Current studies on botulism in ducks. Trans. 17th N. A. Wildl. Conf., pp. 160–167, 3 photos.—Progress report on attempts to induce the development of *Clostridium botulinum*, type C, on small experimental plots.—J. J. H.

POST, GEORGE. 1952. The effects of aldrin on birds. Journ. Wildl. Mgt., **16:** 492–497, 1 table.—The critical oral toxicity of this insecticide for *Phasianus colchicus* is 40 mg. per kg. of body weight. Applications of 2 oz. of aldrin per acre in kerosene for grasshopper work had no noticeable lethal effects on birdlife in the short-grass range of central Wyoming, but songbirds apparently left sprayed areas in search of food.—J. J. H.

PRESTWICH, ARTHUR A. 1952. Records of parrots bred in captivity. Part VI. (Grass Parrakeets). (A. A. Prestwich, London), pp. 289–376.

RAND, AUSTIN L. 1952. Secondary sexual characters and ecological competition. Fieldiana-Zool., **34:** 65–70, 2 figs.—A stimulating discussion of the possible rôle, in some species of birds, of certain secondary sexual characters in the reduction of ecological competition between the sexes. Examples are given of behavioral differences tending to segregate the sexes at certain seasons, and of structural dimorphism (bill modifications, tail development, size) tending to produce sexual differences in food habits. This notion has a two-fold significance: a short-term one reducing intra-specific competition for food, and a long-term, evolutionary one tending to increase the sexual dimorphism within the species.—P. S. H.

RANDLE, WORTH, and RONALD AUSTING. 1952. Ecological notes on Long-eared and Saw-whet owls in southwestern Ohio. Ecology, **33:** 422–426.—The roosting and feeding habits of the two species of owls are discussed. While the roosting habits of the two species appear to be identical, analysis of pellets shows that there is not extensive competition for food. The Long-eared Owls are chiefly field-foragers, the Saw-whet Owls chiefly woodland foragers. This difference in hunting habits allows the two owls to exist in close proximity to one another.—P. S. H.

REEVES, MAURICE C. 1952. Mechanical aids useful in studying Bobwhite Quail. Journ. Wildl. Mgt., **16:** 316–319, 1 fig., 1 photo.—A two-compartment cage is described as facilitating banding operations and permitting the quail to be released as a covey. Improvements are reported on the Stoddard trap, which uses a male to decoy females, and on the standard quail trap. Age and hatching-date calculations can be speeded up with a modification of the slide-rule principle.—J. J. H.

RIPLEY, S. DILLON. 1952. Additional comments on Philippine birds and a new record from the archipelago. Condor, **54:** 362.—A specimen of *Ardeola bacchus* (Bonaparte) is newly reported from Luzon. Attention is called to an additional record of *Ptilinopus leclancheri leclancheri* from Davao, Mindanao Island. *Edolisoma panayense* (Steere) is renamed *Coracina ostenta*.—W. H. Behle.

RIVOIRE, ANDRÉ. 1952. Les oiseaux de la montagne Sainte-Victoire. Alauda, **20**: 85–101, 3 figs.—A list of 60 species observed on this mountain. Nesting and other notes on *Accipiter gentilis, Aquila chrysaetos, Hieraaetus fasciatus, Coracia pyrrhocorax,* and *Monticola solitarius*. The mountain is only 3000 feet high and the regular breeding of *Aquila chrysaëtos* is notable.

SALINGER, HERBERT E. 1952. A Pheasant breeding population study on irrigated lands in southwest Idaho. Journ. Wildl. Mgt., **16**: 409–418, 1 fig., 4 tables.—Clutch size in *Phasianus colchicus* before June 15 averaged 9.3 in 1949, 10.3 in 1950. Eggs were "99.02" per cent fertile. Nests averaged 29 per 100 acres of alfalfa, and 25 in clover. When these were mowed, more than half the hens were killed. Shrinking clutch size is reported as the season progresses, but the data (successive means of 11.2, 11.5, 12.1, and 9.8) require a more rigorous analysis than the author mentions in his paper.—J. J. H.

SAPIN-JALOUSTRÉ, J. 1952. Découverte et description de la rookery de Manchot empereur (*Aptenodytes forsteri*) de Pointe Géologie (Terre Adélie). L'Oiseau, **22**: 143–184, 4 pls., 4 figs.—The first part of an important, thorough, and very well illustrated article on the Emperor Penguin. The author starts with a long and interesting historical section which is a summary of the various expeditions starting with the second expedition of Cook in 1772–1775. This expedition apparently brought back no specimens, but drawings of the birds encountered were made by G. and J. R. Forster. One of these, although labeled *A. patagonica*, is thought to be the first record of *A. forsteri*, but the present author, who reproduces this drawing, states that it is impossible to say whether the species depicted is really *A. patagonica* or *A. forsteri*. In this introductory section the author lists the known rookeries which he believes are not permanent and estimates that the present total number of individuals represented is less than 100,000.

The second section consists of field notes and an account of the discovery of the rookery at Pointe Géologie, which is estimated as between 9,000 and 10,000 individuals. Notes on behavior, food, and nesting are given. The mortality from the time that the egg is laid until the young molts is estimated as between 80 and 90 per cent. The body temperature of adults varies between 38 and 38.5 degrees centigrade, and the birds are free of ectoparasites.—C. Vaurie.

SAUNDERS, GEORGE B. 1952. Waterfowl wintering grounds of Mexico. Trans. 17th N. A. Wildl. Conf., pp. 89–100.—River deltas, coastal lagoons, and bays are preferred; the Gulf Coast populations vary from 750,000 to more than 3,000,000, Pacific coast ones from 980,000 to over 5,000,000; *Anas acuta* is the commonest species.—J. J. H.

SAYAMA, KENJI, and OSCAR BRUNETTI. 1952. The effects of sodium fluoroacetate (1080) on California Quail. Calif. Fish and Game, **38**: 295–300, 2 tables.—Minimum lethal doses lie between 1 and 5 mg./kg. of body weight. Histopathological changes in *Lophortyx californica* are not specific for this particular poison.—J. J. H.

SCHAUB, B. M. 1953. A Device for Removing Overlapping Bands from Birds' Legs. Bird-Banding, **24**: 12–14.

SCOULER, LLOYD. 1952. Crop depredation by waterfowl. Trans. 17th N. A. Wildl. Conf., pp. 115–123.—Review of a serious conservation problem in California; state and federal officials are not agreed on its solution.—J. J. H.

SEAMAN, G. A. 1952. The mongoose and Caribbean wildlife. Trans. 17th N. A. Wildl. Conf., pp. 188–197, 1 table.—*Herpestes javanicus* has reduced introduced *Colinus virginianus* to a remnant population on the U. S. Virgin Islands, has probably resulted in the near extinction of the quail dove (*Oreopeleia mystacea*)

and has probably caused seabirds to abandon Buck Island as a nesting ground. The Pearly-eyed Thrasher (*Margarops fuscatus*) may have to share the blame for a depleted fauna.—J. J. H.

SEUBERT, JOHN L. 1952. Observations on the renesting behavior of the Ring-necked Pheasant. Trans. 17th N. A. Wildl. Conf., pp. 305–329, 1 fig., 10 tables.—When 121 initial nests of *Phasianus colchicus* were deliberately disrupted in an enclosure, 68 hens renested after intervals of time associated with the length of time since the last egg was laid. Hens nested within territories of their cocks. Despite the high artificial density, intraspecific strife (labeled "inter-specific" by the author) was not observed to interfere with nesting.—J. J. H.

SLABÝ, OTTO. 1951. O chondrifikaci primordiálního krania u kosa (*Turdus merula* L.) s hlediska fylogenetické a oekologické morfologie. Sylvia, **13**: 103–121, 7 figs., 1 plate.—On the chondrification of the primordial cranium of the Blackbird (*Turdus merula* L.). Russian and English summaries.

STANFORD, JACK A. 1952. An evaluation of the adoption method of Bobwhite Quail propagation. Trans. 17th N. A. Wildl. Conf., pp. 330–337, 1 photo, 4 tables.—Wild-trapped *Colinus virginianus*, especially males, will occasionally adopt hatchery-produced chicks. This paper was originally processed as a separate publication by the Missouri Conservation Commission.—J. J. H.

STOKES, ALLEN W. 1952. Pheasant survival studies on Pelee Island, Ontario, 1946–1950. Trans. 17th N. A. Wildl. Conf., pp. 285–293, 2 figs., 2 tables.—Annual hen survival of *Phasianus colchicus* was 35–63 per cent. The species failed to increase in 1950 because of lowered hen survival. Annual survival of cocks was 6–12 per cent, 78–93 per cent of all males being shot.—J. J. H.

STONER, DAYTON, and LILLIAN C. STONER. 1952. Birds of Washington Park, Albany, New York. N. Y. State Mus. Bull. 344: 1–268, 52 figs.—This intensive study of the birds of a city park was initiated by the Stoners in 1933 and brought to completion by Mrs. Stoner after her husband's death in 1944. One hundred-and-twenty-two species and subspecies are included in the accounts which contain valuable information on migration dates, frequency of occurrence, and habits.—R. W. S.

TAYLOR, HELEN, and JOE TAYLOR. 1952. Florida—March, 1952. Goshawk, **5**: 13–16.—Sight record of Black-bellied Tree Duck near Tamiami Trail, March 18.—H. D. M.

DEL TORO, MIGUEL ALVAREZ. 1952. Los Animales Silvestres de Chiapas. Dept. Prensa y Turismo, Chiapas, Mexico. pp. 1–247.—Chiapas is one of the more isolated and less developed of Mexican states. Yet its capital, Tuxtla Gutierrez, has a surprising number of cultural institutions. Among them are a fine museum and a zoo, both the achievements of Dr. Alvarez del Toro, who fills the rôles of scientist, collector, taxidermist, artist, and author! Birds are his favorite group, and the present volume provides an excellent introduction to the rich avifauna of the tropics of southern Mexico. The appearance, habits, status, and food of each bird is briefly given, and many of the species are illustrated. This book will be of interest to the scientist and to the amateur naturalist who are visiting Mexico and wish to become familiar at one and the same time with the fauna and with the language.—Dean Amadon.

DEL TORO, MIGUEL ALVAREZ. 1952. Contribución al conocimiento de la Oologia y Nidologia de las aves chiapanecas. Ateneo (Organo del Ateneo de Ciencias y Artes de Chiapas, Tuxtla Gutierrez, Chiapas, Mexico), **2** (4): 11–21, 17 figs.—Notes on the nests of 22 species of birds in Chiapas.

TURČEK, FRANT. J. 1951. O stratifikácii vtáčej populácie lesných biocenóz typu Querceto-Carpinetum na južnom Slovensku. Sylvia, **13:** 71–86, 2 figs., 10 tables. —On the stratification of the avian population of the Querceto-Carpinetum forest communities in southern Slovakia. English summary.

VAURIE, CHARLES. 1952. Geographical variation in the Chat Flycatcher (*Bradornis infuscatus*). Amer. Mus. Novit., No. 1599: 1–9.

WAGNER, FRED H. 1953. Are we overshooting our Pheasant cocks? Wisconsin Cons. Bull., **18**(1): 13–15.—State-wide Wisconsin censuses disclosed a ratio of 1 cock *Phasianus colchicus* per 3.6 hens in the winter of 1950–51 and 1–3.7 a year later. County variations range from 1–0.7 [unhunted] to 1–10.—J. J. H.

WETMORE, ALEXANDER. 1952. The Birds of the Islands of Taboga, Taboguilla, and Uravá, Panamá. Smiths. Misc. Coll. **121:** 1–32, 3 pls.—Annotated list of 54 forms. Revisions of *Amazilia edward* and *Saltator albicollis*. *Amazilia edward ludibunda, Amazilia edward collata, Elaenia flavogaster cristula*, and *Saltator albicollis melicus*, new subspecies.

WETMORE, ALEXANDER, and WILLIAM H. PHELPS, JR. 1951. Observations on the geographic races of the tinamou *Crypturellus noctivagus* in Venezuela and Colombia. Bol. Soc. Venezolana de Ciencas Nat., **13:** 115–119, 1 map.

WHARTON, WILLIAM P. 1953. Recoveries of Birds Banded at Groton, Massachusetts, 1932–1950. Bird-Banding, **24:** 1–7.—Forty years of banding resulted in 146 recoveries, 95 of them more than 20 miles from Groton and thus regarded as "true recoveries;" this is one-fourth of 1 per cent of the 38,057 birds banded. Six maps show places of recoveries for 9 species.

WILCOX, HARRY H. 1952. The pelvic musculature of the Loon, *Gavia immer*. Amer. Midl. Nat., **48:** 512–573, 26 pls., 2 tables.—This is an excellent study, based on the dissection of 25 specimens. The complete description and illustration of each muscle is of great value as a basis for future comparative work. The function of each muscle is noted, and the interactions of the muscles in the highly modified style of locomotion in this species are discussed in detail.

The musculature of the Loon must be very constant in its form and relation, as compared to other birds for which we have comparable details, for few variations are mentioned.—Harvey I. Fisher.

WILLIAMS, GEORGE G. 1952. The origins and dispersal of oceanic birds. Texas Journ. Sci., **4** (2): 139–155, 2 figs.—A series of hypotheses intended to explain the distribution of "oceanic" families of birds. The subject is a very controversial one, but, unfortunately, many statements which this author must have intended as pure hypothesis are expressed as flat, unguarded statements.

WILLIAMS, GORDON R. 1952. The California Quail in New Zealand. Journ. Wildl. Mgt., **16:** 460–483, 1 fig., 10 tables.—*Lophortyx californica* was introduced between 1862 and 1870 and is now widespread between sea level and 6,000 feet and in rainfall varying from 13 to 100 inches per year. Heath and grassland are favored. Summer densities run about a bird per acre. Sex ratios generally follow those reported in America but have recently become markedly unbalanced as the age ratios displayed a dramatic failure in annual recruitment of young to the population. There is no clear-cut evidence for the operation of Allen's or Bergmann's laws on this species in New Zealand at the present time.—J. J. H.

WINTERBOTTOM, J. M. 1952. Observations on the Breeding of the South African Hoopoe [*Upupa epops*]. Ostrich, **23:** 82–84.

WOODGERD, WESLEY. 1952. Food habits of the Golden Eagle. Journ. Wildl. Mgt., **16:** 457–459, 1 table.—Among 51 stomachs of *Aquila chrysaëtos*, jack rabbits

or cottontail remains comprised the sole contents of 22 and the partial contents of 10.—J. J. H.

YOCUM, CHARLES F. 1952. Techniques used to increase nesting of Canada Geese. Journ. Wildl. Mgt., **16**: 425–428, 3 photos.—Near the Washington-British Columbia boundary where *Branta canadensis* nests in trees, 3 sportsmen have increased the population by anchoring iron wash tubs and woven willow baskets high in yellow pines, in the lower crotches of large willows, or on sloping tree trunks. About 650 goslings have been hatched in these devices.—J. J. H.

ZIMMER, JOHN T. 1952. Studies of Peruvian Birds. No. 62. The hummingbird genera *Patagona, Sappho, Polyonymus, Ramphomicron, Metallura, Chalcostigma, Taphrolesbia,* and *Aglaiocercus.* Amer. Mus. Novit., No. 1595: 1–29.

ZIMMER, JOHN T. 1953. Studies of Peruvian Birds. No. 63. The hummingbird genera *Oreonympha, Schistes, Heliothryx, Loddigesia, Heliomaster, Rhodopis, Thaumastura, Calliphlox, Myrtis, Myrmia,* and *Acestrura.* Amer. Mus. Novit., No. 1604: 1–26.—*Myrtis fanny megalura* (Malca, Cajabamba, Perú), new subspecies.

ZIMMER, JOHN T. 1953. Notes on Tyrant Flycatchers (Tyrannidae). Amer. Mus. Novit., No. 1605: 1–16.—*Myiarchus tuberculifer littoralis* (El Zapotal, Guanacaste, Costa Rica), *Idioptilon mirandae kaempferi* (Salto Pirahy [= Joinville], Santa Catarina, Brazil), and *Hemitriccus obsoletus naumburgae* (Sinimbú, Rio Grande do Sul, Brazil), new subspecies. Notes on other species, some rare and little known.

ZIMMER, JOHN T., and WILLIAM H. PHELPS. 1952. A new race of the honeycreeper, *Diglossa cyanea,* from Venezuela. Amer. Mus. Novit., No. 1603: 1–2.—*Diglossa cyanea tovarensis* (Colonia Tovar, Aragua, Venezuela), new subspecies.

LETTER TO THE EDITOR

CORRECTION CONCERNING THE BREEDING OF *Apus pallidus* AT BANYULS, FRANCE

We have just seen the statement in the Auk for July 1952: 339, quoted from the editor of L'Oiseau vol. 21: 216, suggesting that our friends David and Elizabeth Lack acted improperly in publishing the first breeding record of *Apus pallidus* for France in Alauda 19: 49, and that credit for the discovery was really ours. In this connection we beg to state that although we had ourselves seen the Swifts some days previously, Dr. and Mrs. Lack found them quite independently of us, and it was they not we who first identified the species concerned. Their attitude in publishing in Alauda was therefore perfectly correct.

L. Hoffmann
H. Wachernagel

OBITUARIES

DONALD ROLAND BEMONT, an Associate of the American Ornithologists' Union since 1950, died at Ithaca, New York, March 28, 1951. He was born at Ste. Anne de Bellevue, Quebec, Canada, May 9, 1929. After spending two years at Alfred University, he entered Cornell University in the autumn of 1949 as a student in wildlife conservation. Death occurred through a fall while working with a tree-trimming crew during the spring vacation. He had lived in Ithaca since the age of eight and acquired an interest in birds while a mere lad. Before entering the University he was well known to the ornithologists of Ithaca.—A. W. SCHORGER.

MARTIN JOACHIM BURELBACH, elected an Associate of the American Ornithologists' Union in 1940, died in Chattanooga, Tennessee, January 26, 1952. He was born in Perham, Minnesota, September 18, 1884. In 1905 he enlisted in the 12th Cavalry and was discharged three years later. In World War I, he graduated from the First Training Camp, Fort Oglethorpe, Georgia, with the rank of Captain, and was a Major when discharged in 1920. From 1914 to 1917, he was Scout Executive of the Boy Scouts of America at Chattanooga; and from 1920, until his retirement in 1948, he was connected with the Department of Education of the Chattanooga schools.

Major Burelbach made an important contribution to the public interest in nature and natural areas in the numerous articles which he published in outdoor and nature magazines. These were illustrated with his own photographs. He was unusually successful as an amateur photographer and his pictures were exhibited in many salons both at home and abroad. One print won a prize of $500. Among the organizations to which he belonged were the Tennessee Ornithological Society, National Wildlife Federation, and National Audubon Society. On July 19, 1911, he was married to May Dunbar, who survives him.—A. W. SCHORGER.

ELAINE MARTIN DREW (MRS. HOWARD A. DREW), elected an Associate of the A.O.U. in 1934, died in Barre, Vermont, after a long illness on December 22, 1952. Born in Chattanooga, Tennessee, on July 8, 1886, she graduated from Castle Heights Academy in Lebanon, Tenn., and later attended Barnard College and Teachers College. She also spent one year in the American School of Osteopathy. She taught school in Moultrie, Georgia, and in Houston, Texas. A member of the Northeastern Bird-Banding Association, Mrs. Drew was also a member and former Vice-President of the Vermont Bird Club, a member of the National and Massachusetts Audubon Societies, the Granite City Garden Club (Barre), and the Green Mountain Club. For fifteen years Mrs. Drew was an active bander for the Fish and Wildlife Service and banded more than 10,000 birds. One winter she banded 1500 Purple Finches. She had the distinction of having banded, with the assistance of Wendell P. Smith, the only Gannet ever recorded in Vermont. Mrs. Drew trapped and identified a Hoary Redpoll (*Acanthus hornemanni exilipes*), in April 1942. The skin, the first record for Vermont, is now in the Museum of Comparative Zoology. She had contributed a few articles and bird photographs to some more popular magazines. Of a quiet, modest, and friendly nature Mrs. Drew was always glad to share her experiences with anyone interested in birds. She was a careful and accurate observer and kept a sustained interest in banding and birdlife even after illness had restricted her activity. She will be greatly missed by her friends, while her death has removed one of the keenest amateur ornithologists from Vermont. Besides her husband she is survived by a sister and two brothers.—THOMAS H. FOSTER.

ELIZABETH WILSON FISHER, an Honorary Life Associate of the American Ornithologists' Union, elected in 1896, died at her home in Philadelphia, April 12, 1938, at the age of 74. She was the daughter of Coleman and Mary Wilson Fisher and was born in Philadelphia, December 24, 1864. For some time she was Secretary of the Pennsylvania Audubon Society and was active in bird protection in the State.—T. S. PALMER.

HARRY LEE HARLLEE, elected an Associate of the American Ornithologists' Union in 1932, died in the Bruce Hospital, Florence, South Carolina, February 22, 1952. He was born in Claussen, S. C., September 27, 1876, and was a grand nephew of General William Wallace Harllee who founded the city of Florence. In World War I, he served as captain in the artillery for 17 months. At the time of his death he was president of the Harllee-Quattlebaum Construction Company. The Harllee Museum that he established at Florence had an excellent collection of native birds and their eggs. His ornithological publications appear to be limited to two short notes in 'The Auk' (1933: 217; 1949: 206). In July, 1951, while on a trip to Alaska to collect fish and birds for his museum, he was stricken with an illness that ended in death several months later.—A. W. SCHORGER.

DR. GEORGE STANFORD HENSYL of Mahanoy, Pennsylvania, an Associate of the American Ornithologists' Union, elected in 1941, died of coronary thrombosis July 27, 1942. He was born in 1886 and was graduated from Jefferson Medical College in 1909. He served on the staffs of the Ashland State Hospital and the Locust Mountain State Hospital of Shenandoah, Pennsylvania. So far as known, he published little or nothing on birds. A brief account of his activities appeared in the Journal of the American Medical Association in 1942.—T. S. PALMER.

MARGARETTA MASON (MRS. WHARTON) HUBER, elected an Associate of the American Ornithologists' Union in 1926, died in Pottstown, Pennsylvania, February 1, 1952, aged 74. She was born in Philadelphia on January 25, 1878. On her father's side she was related to Charles Mason who surveyed the Mason and Dixon Line. Her home contained many priceless antiques, many from Colonial times, inherited from her ancestors. Some of the heirlooms belonged to Thomas Voigt, first coiner of the U. S. Mint, who was related to her mother. Her husband, Wharton Huber, at the time of his death in 1942, was Curator of Mammals, Academy of Natural Sciences of Philadelphia (Auk, 1943: 313). Mrs. Huber accompanied him on many of his expeditions and donated his valuable collection of birds to the Reading Museum. During most of her later years, Mrs. Huber was active in the Visiting Nurse Society of Pottstown, and served as its president for two terms.—A. W. SCHORGER.

PHILIP LAURENT, an associate of the American Ornithologists' Union, elected in 1902, died of coronary heart disease at his home in Germantown, Philadelphia, Pennsylvania, June 17, 1940, at the age of 83. He was the son of Frederic C. Laurent and Mary Anne Demme and was born in Germantown March 26, 1857. He was elected an Associate of the Union in 1902. Laurent was primarily an entomologist, and although he maintained his membership in the Union for 38 years, apparently wrote little, if anything, on birds.—T. S. PALMER.

CHARLES ANDREW MCNEIL, of Sedalia, Missouri, an Associate of the American Ornithologists' Union, died of coronary embolism May 17, 1944, at the age of 68. He was born in 1875, graduated from the St. Louis School of Medicine in 1905, and

served on the staff of the Missouri, Kansas, and Texas Railroad Hospital. He also was President of the Union Savings Bank of Sedalia. He was elected an Associate of the Union in 1919, but apparently published nothing on birds during the period of his membership.—T. S. PALMER.

SAMUEL NICHOLSON RHOADS, a Life Associate of the American Ornithologists' Union, died December 27, 1952, at the Lakeland Hospital, Blackwood, New Jersey, aged 90. He was born in Philadelphia on April 30, 1862. He was one of the oldest members of the Union, having been elected in 1885. Following a brief course in journalism at Harvard University, he continued his education at the Academy of Natural Sciences and the Museum of Science and Art, both of Philadelphia, and the Carnegie Museum, Pittsburgh. In 1893 he began a long series of trips during which he collected in nearly every state in the Union, Mexico, Cuba, and Central and South America. His writings cover mammals, birds, reptiles, and mollusks, nearly 100 new species and forms of birds and mammals being described. Mammals occupied most of his attention, his best known work being, 'The Mammals of Pennsylvania and New Jersey' (1903). His name appears on approximately 32 ornithological papers between the years 1879–1923. These were published in the Proc. Acad. Nat. Sci. of Philadelphia, and, principally, in 'The Auk.' Most of the bird skins that he collected are in the Academy of Natural Sciences. He was a close friend of the late Witmer Stone.

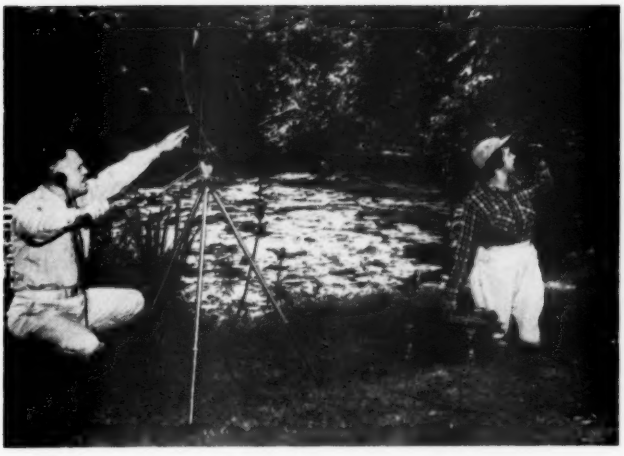
In 1906, following a brief period as a real estate agent, he began the operation of the Benjamin Franklin Book Store, 1920 Walnut Street, Philadelphia, and specialized in the sale of rare old ornithological works. This activity was continued until about 1925. He was an invalid during the last 25 years of his life. Mr. Rhoads was an Honorary Member of the Delaware Valley Ornithological Club and the last of the founders of this organization. He was also a member of the American Philosophical Society and a life member of the Academy of Natural Sciences.—A. W. SCHORGER.

JAMES SPEAR, JR., of Wallington, Pennsylvania, an Associate of the American Ornithologists' Union, died in the Friends Hospital, Philadelphia, Pa., August 31, 1934, at the age of 55. He was the son of James Spear and Louise Muller. He was born in Philadelphia January 1, 1879, and was elected an Associate of the Union in 1926. During the eight years of his membership he published little or nothing on birds.—T. S. PALMER.

ARTHUR JASON WOODWARD, elected an Associate of the American Ornithologists' Union in 1935, was born at Lancaster, New Hampshire, January 8, 1884. He was an electrical engineer by profession. After graduating from the University of New Hampshire in 1907, he was associated with the General Electric Company until 1949. He was a member of the Buffalo Ornithological Society and the Audubon Society at Schenectady, New York. An interest in birds dating from childhood did not lead to any ornithological publications. Death occurred at Clearwater, Florida, March 18, 1952.—A. W. SCHORGER.

CORRIGENDUM

Volume 69 (4): 485, line 38: for "east to west" read "west to east."



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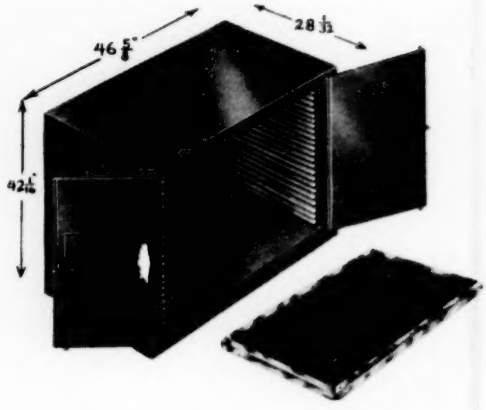

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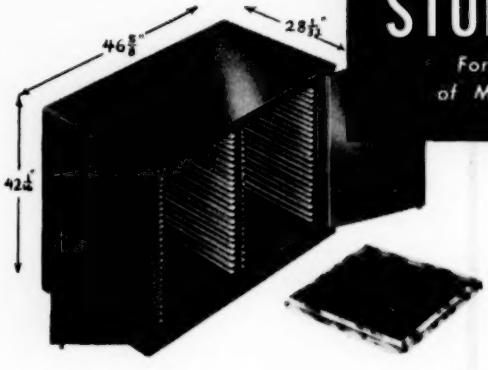

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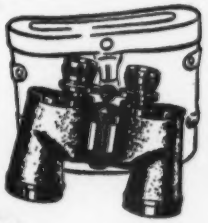

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